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National Park Service Vegetation Inventory Program

Sleeping Bear Dunes National Lakeshore, Michigan

Natural Resource Report NPS/GLKN/NRR—2011/395



ON THE COVER
A view of Pierce Stocking of the Sleeping Bear Dunes, as seen from near the Empire Bluffs area, Sleeping Bear Dunes National Lakeshore, Michigan.
Photograph by Kevin Hop.

National Park Service Vegetation Inventory Program

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Natural Resource Report NPS/GLKN/NRR—2011/395

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Executive Summary

The National Park Service (NPS) Vegetation Inventory Program (VIP) is an effort to classify, describe, and map existing vegetation of national park units for the NPS Natural Resource Monitoring (I&M) Program. The NPS VIP is managed by the NPS Biological Resources Management Division and provides baseline vegetation information to the NPS Natural Resource I&M Program. The U.S. Geological Survey (USGS) Vegetation Characterization Program lends a cooperative role in the NPS VIP. The USGS Upper Midwest Environmental Sciences Center, NatureServe, NPS Great Lakes Network, and NPS Sleeping Bear Dunes National Lakeshore have completed vegetation classification and mapping of Sleeping Bear Dunes National Lakeshore (SLBE) and surroundings.

Photointerpreters, ecologists, and botanists collaborated to identify and describe vegetation types within the National Vegetation Classification Standard (NVCS) and to determine how best to map them by using aerial photographs. The team collected 120 vegetation sampling plots within the SLBE project extent. Furthermore, data from 1,024 accuracy assessment (AA) sites were collected (of which 1,016 were used to test accuracy of the vegetation map layer). These data sets led to the identification of 51 floristic types (of which 50 are at the association level and one is at the alliance level) in the NVCS at SLBE. Additional vegetation types are recognized at the group level of the NVCS.

A total of 75 map classes (including map-class phases) were developed to map the vegetation and general land cover of SLBE and environs, including the following: 67 map classes representing natural/semi-natural vegetation types at various levels in the NVCS, four map classes representing cultural vegetation (e.g., developed lands) in the NVCS, and four map classes representing non-vegetation features (e.g., open-water bodies). Features were interpreted by using high-quality stereoscopes over light tables and 1:12,000-scale, color-infrared aerial photographs dated October 2007 (during fall leaf change). Polygon units were mapped to a 0.5-ha minimum mapping unit. An ancillary set of 1:12,000-scale, true-color aerial photographs dated April 2007 (during leaf-off conditions) covering the entire SLBE lands were used for additional reference during mapping. The interpreted data were digitally and spatially referenced, making the spatial database layers usable in geographic information systems.

A geodatabase containing various feature-class layers and tables show the locations of vegetation types and general land cover (vegetation map), vegetation plot samples, AA sites, project boundary extent, and aerial photographic centers. The feature class layer for the SLBE vegetation map provides 9,296 polygons of detailed attribute data covering 33,740.7 ha, with an average polygon size of 3.6 ha. Of the area mapped, 8,886 polygons (95.6%) represent natural/semi-natural types in the NVCS, encompassing 26,775.2 ha (79.4%) of the total map extent.

Summary reports generated from the vegetation map layer indicate that forest types (primarily the Beech - Maple - Northern Hardwoods Forest community) dominate the vegetation landscape (NVCS types), populating 71.2% of polygons and covering 81.1% of area. A thematic AA study was conducted of map classes representing floristic types in the NVCS. Results present an overall accuracy of 77.8% (kappa index of 76.7%) based on data from 1,016 of the 1,024 AA

sites. Most individual map-class themes exceed the NPS VIP standard of 80% with a 90% confidence interval.

The SLBE vegetation mapping project delivers many geospatial and vegetation data products in hardcopy and digital formats. These products consist of an in-depth project report discussing methods and results, which include descriptions and a dichotomous key to vegetation types, map classification and map-class descriptions, and a contingency table showing AA results. The suite of products also includes ground photos of vegetation types; a database of vegetation plots and AA sites; field data sheets; aerial photographic prints and images; hardcopy and digital maps; and a geodatabase of vegetation types (map layer), fieldwork locations (vegetation plots and AA sites), aerial photographic indexes, project boundary, and metadata. All geospatial products are projected in Universal Transverse Mercator, Zone 16, by using the North American Datum of 1983. More NPS VIP information and products of completed park mapping projects are on the Internet at <http://biology.usgs.gov/npsveg>.

Acknowledgments

The success of this complex project was dependent on the collaborative efforts of several individuals from various organizations. The dedicated folks who worked on this project collectively have a wide array of skill and expertise, essential in moving the National Park Service (NPS) Sleeping Bear Dunes National Lakeshore (SLBE) vegetation mapping project to its completion. We wish to acknowledge those individuals who have been essential in making this project a success.

We respectfully thank the NPS Vegetation Inventory Program (VIP) and the U.S. Geological Survey (USGS) Vegetation Characterization Program (VCP) staff for entrusting this project to us, including Karl Brown (NPS VIP Coordinator) for funding the SLBE vegetation mapping project, Mike Mulligan (USGS VCP Coordinator) for providing additional funding support for the vegetation mapping effort, and Chris Lea and Tammy Cook (NPS VIP) for giving us guidance when we needed it.

We also thank Bill Route and Ulf Gafvert of the NPS Great Lakes Network for supporting and coordinating a cluster approach to classify and map the remaining six national park units within the network. Further thanks are given to Ulf for managing the acquisition of fall, color-infrared aerial photography for the project, and furthermore, for providing an additional set of spring, leaf-off, true-color aerial photographs, which greatly assisted us in our mapping.

Thanks are also in order to the NPS SLBE staff—particularly Amanda Brushaber and Steve Yancho—for hosting this project, with its series of meetings, training sessions, and field efforts. Amanda was also particularly helpful to the field crews as a liaison with other park staff by arranging housing, setting up transportation to the Manitou Islands, and performing many other logistical tasks that allowed our field crews to focus on data collection. The staff provided the project with valuable local knowledge of the landscape of SLBE and insight into local management and research needs.

We also acknowledge and thank our field teams who spent many hours collecting the data that formed the basis of so much of this project. We thank Mike Kost of the Michigan Natural Features Inventory for providing classification assistance and for supervising field crews collecting data at vegetation plots. We recognize Brian Beachy, Jessica Beachy, Bill Martinus, and Chip Schaddlee for collecting data at vegetation plots. We also recognize our field team for data collection at AA sites, including Lead Ecologists, Liana May and Ken Hiser, and Field Assistants, Jennie Jacobson and Peter Weeks.

We finally thank our colleagues from within our own offices—the USGS Upper Midwest Environmental Sciences Center and NatureServe. Of the USGS, we acknowledge Eric Seeger for assisting with field work and quality control of the photointerpretative mapping, as well as his role in the analysis for AA; Cris Calogero for orthorectification and map automation; and JC Nelson and the student geographic information system lab for quality control of map automation, as well as JC's assistance with random-site selection for AA, development of the geodatabase, and preparing metadata. Of NatureServe, we acknowledge Mary Russo for getting classification data into and out of the central database of NatureServe with ease and speed and Don Faber-Langendoen for consulting with us on the vegetation classification.

This project required the cooperation and assistance of many individuals. Their diligence in working on this multifarious project is highly regarded and appreciated because their labors went toward so many aspects of this project—from developing the vegetation classification to creating the spatial geodatabase.

Introduction

Sleeping Bear Dunes National Lakeshore Vegetation Mapping Project

The Sleeping Bear Dunes National Lakeshore (SLBE) vegetation mapping project is an initiative of the National Park Service (NPS) Vegetation Inventory Program (VIP), with cooperative support from the U.S. Geological Survey (USGS) Vegetation Characterization Program (VCP) to classify and map plant communities of SLBE. The goals of the project are to adequately describe and map plant communities of SLBE and its immediate surroundings and to provide the NPS Natural Resource Inventory and Monitoring (I&M) Program, resource managers, and biological researchers with useful baseline vegetation information.

The SLBE vegetation mapping project is also part of a cluster approach to classify and map plant communities of the remaining park units within the Great Lakes Network (GLKN) of the I&M Program. A cluster approach provided an avenue for advancing consistency of the vegetation classification throughout the network as well as the mapping thereof. With Voyageurs National Park and Isle Royale National Park already completed (mid-1990s), six GLKN park units needing vegetation inventory remained, including the Apostle Islands National Lakeshore, Grand Portage National Monument, Indiana Dunes National Lakeshore, Pictured Rocks National Lakeshore, Saint Croix National Scenic Riverway, and Sleeping Bear Dunes National Lakeshore. With this cluster of six park units, an approach was taken to classify and map the vegetation of these park units in a somewhat staggered timeline (Table 1), providing some opportunity to share results and experiences from park units of the same regional locale.

Table 1. Timeline of the vegetation mapping initiative for the Great Lakes Network.

[AA, Accuracy Assessment; Clsf, Classification; Mtg, Meeting; Veg, Vegetation]

National Park	2004	2005	2006	2007	2008	2009	2010	2011
Indiana Dunes National Lakeshore	Air Photos	Scope Mtg Veg Plots	Veg Clsf Mapping	Mapping Field AA	AA Analysis Wrap-up	Product Updates		
Apostle Islands National Lakeshore	Air Photos	Scope Mtg Veg Plots	Veg Plots	Veg Clsf Mapping	Mapping Field AA	AA Analysis Wrap-up	Wrap-up	
Pictured Rocks National Lakeshore		Air Photos	Scope Mtg Veg Plots	Veg Clsf Mapping	Mapping Field AA	AA Analysis Wrap-up	Wrap-up	
Grand Portage National Monument			Air Photos	Scope Mtg Veg Plots	Mapping	Field AA AA Analysis	Wrap-up	
Sleeping Bear Dunes National Lakeshore				Scope Mtg Veg Plots Air Photos	Veg Clsf Mapping	Mapping Field AA	AA Analysis	Wrap-up
Saint Croix National Scenic Riverway		Air Photos	Scope Mtg Veg Plots	Veg Plots Veg Clsf Mapping	Veg Clsf Mapping	Mapping Field AA	Field AA AA Analysis	AA Analysis Wrap-up

We officially inaugurated the SLBE vegetation mapping project in spring of 2007, with a scoping meeting wherein partners discussed project objectives, goals, and methods. Major collaborators at this meeting included staff from the NPS GLKN, the NPS SLBE, NatureServe, and the USGS. Common to all NPS VIP projects, the three major components of the SLBE vegetation mapping project are as follows: (1) vegetation classification, (2) vegetation mapping, and (3) map accuracy assessment. In this report, we discuss each of these fundamental components in detail.

The National Park Service Vegetation Inventory Program

The NPS VIP is an effort to classify, describe, and map existing vegetation of national park units. Managed by the NPS Biological Resources Management Division, the NPS VIP provides baseline vegetation information for the NPS Natural Resource I&M Program. The USGS VCP lends a cooperative role in the NPS VIP. Vegetation layers and associated information support a wide variety of resource assessment, park management, and planning needs. They also provide structure for framing and answering critical scientific questions about vegetation communities and their relation to environmental processes across the landscape.

Program scientists developed procedures for classification, mapping, and accuracy assessment (The Nature Conservancy [TNC] and Environmental Systems Research Institute 1994a, 1994b, TNC et al. 1994, NatureServe 2004). Ecology and mapping teams worked together to share knowledge and data and to resolve issues regarding classification and mapping procedures. The NPS VIP products meet Federal Geographic Data Committee (FGDC) standards for vegetation classification and metadata and meet national standards for spatial accuracy and data transfer. Mapping standards include a minimum mapping unit (MMU) of 0.5 ha and classification accuracy meeting or exceeding 80% (with a 90% confidence level) for map classes representing plant communities. All geospatial products are projected in Universal Transverse Mercator (UTM) and use the North American Datum of 1983 (NAD83).

The NPS VIP provides an array of data products. Mapping products include aerial photographs, spatial databases of vegetation (including metadata), map classification description or key, hard-copy maps of vegetation, and accuracy assessment of the vegetation map. Vegetation products include vegetation classification, dichotomous field key to the vegetation classes, formal descriptions and ground photos of the vegetation types, and field data in database format. More NPS VIP information and products of completed park mapping projects are on the Internet at <http://science.nature.nps.gov/im/inventory/veg> and <http://biology.usgs.gov/npsveg>.

Natural Resource Inventory and Monitoring Program

The NPS Natural Resource I&M Program is a long-term effort to acquire information needed to help maintain ecosystem integrity for all NPS units with significant natural resources. One of the long-term goals of the I&M Program is to produce baseline inventories of basic biological and geophysical natural resources. The NPS VIP provides detailed vegetation maps based on aerial photographs and meets specified thematic accuracy standards (80%) set by the I&M Program. More information on the I&M Program is available on the Internet at <http://science.nature.nps.gov/im/index.cfm>.

Vegetation Inventory Program Standards

The NPS VIP uses nationally defined standards, some of which are maintained by the FGDC. These include the following:

- National Vegetation Classification Standard (FGDC 2008),
- Content Standard for Digital Geospatial Metadata (FGDC 1998a),
- Spatial Data Transfer Standard (FGDC 1998b),
- United States National Map Accuracy Standards (U.S. Geological Survey 1999), and
- Integrated Taxonomic Information System (U.S. Department of Agriculture).

Descriptions and links to websites for these standards can be accessed at <http://biology.usgs.gov/npsveg/standards.html>.

The National Vegetation Classification Standard

In 1997, the FGDC adopted the Vegetation Classification Standard: FGDC-STD-005-1997 (FGDC 1997). Since then, the FGDC Vegetation Subcommittee has derived a major revision, which is the National Vegetation Classification Standard (NVCS), Version 2: FGDC-STD-005-2008 (Version 2) (FGDC 2008). This revision was an effort to foster a cohesive view between Federal agencies in their approach to classifying vegetation, thus reducing duplicative efforts among multiple agencies. Version 2 replaced the original and addressed several issues known with the first version and included a substantial reorganization of the classification hierarchical structure. The purpose of the classification standard is to promote consistent classification of vegetation resources across regions. The use of a national standard aids effective resource stewardship by augmenting compatibility and widespread use of the information throughout the NPS and other Federal and State agencies.

The NVCS classifies existing vegetation within a hierarchical structure. In brief, the classification is separated into two overriding categories, including natural vegetation (including semi-natural) and cultural vegetation. From there, each category is further divided into three main sections, including the following: (1) Upper (where physiognomy plays a predominant role), (2) Middle (where both floristics and physiognomy play a significant role), and (3) Lower (where floristics plays a predominant role). Within each section, additional levels are subset. Separate hierarchies are developed for cultural and natural vegetation types. Tables 2 and 3 show the hierarchical structures for both natural and cultural vegetation types. Definitions of these various levels are detailed within Section 2 of the NVCS (FGDC 2008); however, with the emphasis given by the NPS VIP to natural/semi-natural vegetation types of the floristic levels (alliance and association) and the group level of the NVCS, we provide some brief definitions with the following paragraph.

An association-level type is the finest level of the NVCS and is “defined on the basis of a characteristic range of species composition, diagnostic species occurrence, habitat conditions and physiognomy” (see Jennings et al. 2006 in FGDC 2008:14). “Associations reflect topo-edaphic climate, substrates, hydrology, and disturbance regimes” (FGDC 2008:14), whereas an alliance-level type is hierarchically one level above the association and is “defined by a characteristic range of species composition, habitat conditions, physiognomy, and diagnostic species, typically at least one of which is found in the uppermost or dominant stratum of the vegetation” (see Jennings et al. 2006 in FGDC 2008:14). “Alliances reflect regional to subregional climate, substrates, hydrology, moisture/nutrient factors, and disturbance regimes” (FGDC 2008:14). A group-level type is hierarchically one level above the alliance (two levels above association) yet is also the lowest level of the middle section of the NVCS hierarchy. The group level is defined in Table 2.4 of the NVCS (FGDC 2008:17) as “combinations of relatively narrow sets of diagnostic plant species (including dominants and co-dominants), broadly similar composition, and diagnostic growth forms that reflect biogeographic differences in composition and sub-continental to regional differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes”.

Table 2. Hierarchy for natural/semi-natural vegetation (with examples) in the National Vegetation Classification Standard, Version 2 (FGDC 2008).

Level	Example
Upper: Physiognomy plays a predominant role.	
Formation Class	Forest & Woodland Class (1.)
Formation Subclass	Temperate Forest (1.C.)
Formation	Temperate Flooded & Swamp Forest (1.C.3.)
Middle: Both floristics and physiognomy play a significant role.	
Division	Northeastern & Central North American Flooded & Swamp Forest (1.C.3.a./D011.)
Macrogroup	Northern & Central Swamp Forest (MG030.)
Group	Northern & Central Alkaline Conifer & Hardwood Swamp (G046.)
Lower: Floristics plays a predominant role.	
Alliance	*Fraxinus nigra* - *Acer rubrum* Saturated Forest (A.347)
Association	*Fraxinus nigra* - Mixed Hardwoods - Conifers / *Cornus sericea* / *Carex* spp. Forest (CEGL002105)

Table 3. Hierarchy for cultural vegetation (with examples) in the National Vegetation Classification Standard, Version 2 (FGDC 2008).

Level	Example
Upper: Physiognomy plays a predominant role.	
Cultural Class	Agricultural Vegetation
Cultural Subclass	Herbaceous Agricultural Vegetation
Cultural Formation	Pasture / Hay
Cultural Subformation	Permanent Pasture & Hayland
Middle: Both floristics and physiognomy play a significant role.	
Cultural Group *[optional]*	Temperate and Tropical Permanent Pasture & Hayland
Cultural Subgroup	Grass
Lower: Floristics plays a predominant role.	
Cultural Type	Co-dominance of tall fescue & perennial ryegrass
Cultural Subtype *[optional]*	

Content Standard for Digital Geospatial Metadata

Metadata are data that describe the content, quality, condition, and other characteristics of other data. As a standard product, the NPS VIP employs FGDC-compliant metadata files for each spatial data set it produces. In 1998, the FGDC approved the Content Standard for Digital Geospatial Metadata, FGDC-STD-001-1998 (FGDC 1998a). This metadata standard uses a common set of terminology and definitions to document digital geospatial data.

Sleeping Bear Dunes National Lakeshore

Location and Brief History

The SLBE (Figure 1) is located in the northwestern Lower Peninsula of Michigan within Benzie and Leelanau Counties. The mainland of SLBE is situated along the shores of Lake Michigan, with two islands, North Manitou and South Manitou, located off shore. The SLBE comprises an area of over 24,000 ha (over 28,000 ha with the ~400 m surface water jurisdiction into Lake Michigan included).

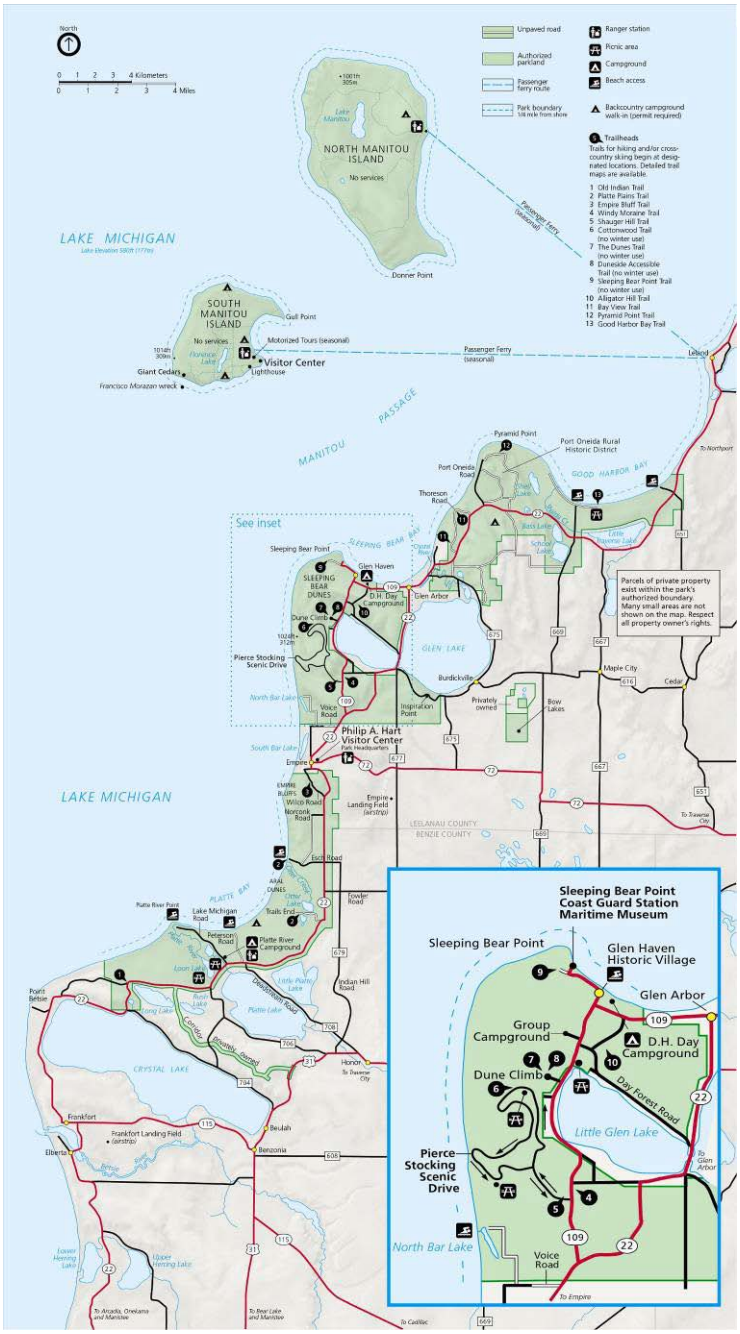


Figure 1. Sleeping Bear Dunes National Lakeshore, Michigan (courtesy nps.gov).

The SLBE was authorized by the U.S. Congress in October 1970 with the Establishment Act for the preservation of the natural resources and for public use. The area has a diverse history with early Native American cultures, European settlement, shipping, logging, and agriculture.

The SLBE offers a variety of destinations and activities, including visitor centers, museums, a historic logging village, scenic drives, hiking trails, camping, canoeing, swimming, fishing, hunting, and bird watching. Ferries from Leland provide access to the Manitou Islands, with much of those islands designated as NPS wilderness area.

Landscape Setting

The most prominent landscape feature at the SLBE is the extensive sand dunes (Figure 2), including the Sleeping Bear Dunes, which is the namesake for this national park unit. These dunes are perched over moraine headlands and rise to over 120 m above Lake Michigan. The dunes are in constant change from winds coming off of Lake Michigan and are only somewhat stabilized by dunal vegetation, such as American beachgrass (*Ammophila breviligulata*) and sand cherry (*Prunus pumila*). Several high points above the shoreline provide for some extensive views of Lake Michigan and the Manitou Islands (Figure 3). Further inland, hardwood forests span the landscape (Figure 4), which are dominated by sugar maple (*Acer saccharum*) and American beech (*Fagus grandifolia*), along with white ash (*Fraxinus americana*), American basswood (*Tilia americana*), and yellow birch (*Betula alleghaniensis*). Remnant farms and old-field meadows from past agricultural practices break up the forested landscape (Figure 5).



Figure 2. Extensive sand dunes at the Sleeping Bear Dunes complex, Sleeping Bear Dunes National Lakeshore, Michigan.



Figure 3. A view of North Manitou Island from Pyramid Point, Sleeping Bear Dunes National Lakeshore, Michigan.



Figure 4. An example of a mixed-hardwood forest, typical of the interior landscape at the Sleeping Bear Dunes National Lakeshore, Michigan.



Figure 5. A remnant agricultural field meadow on North Manitou Island, Sleeping Bear Dunes National Lakeshore, Michigan.

More than 105 km of coastline to Lake Michigan (Figure 6) exist at the SLBE, as well as numerous inland lakes, streams, and other wetlands (Figure 7), making SLBE a diverse interchange between water and land for plants and animals. Beach ridge and swale formations provide an intricate transition between upland and wetland habitats, with excellent examples at Platte Bay, Good Harbor Bay, and the crescent-shaped bay of South Manitou Island. White pine (*Pinus strobes*), red pine (*Pinus resinosa*), and jack pine (*Pinus banksiana*), along with northern red oak (*Quercus rubra*) and/or black oak (*Quercus velutina*) dominate the beach ridges (Figure 8), while wetland vegetation, including herbaceous, shrub, and tree species, dominate the beach swales (Figure 9).



Figure 6. Coastline along Lake Michigan at Sleeping Bear Dunes National Lakeshore, Michigan.



Figure 7. Wetland complex near Shalda Creek, Sleeping Bear Dunes National Lakeshore, Michigan.



Figure 8. A forested beach ridge with jack pine and oaks (northern red and/or black) at the Sleeping Bear Dunes National Lakeshore, Michigan.



Figure 9. An herbaceous wetland within a beach swale at the Sleeping Bear Dunes National Lakeshore, Michigan.

Located along the shores of Lake Michigan, the climate of the SLBE area is maritime-like, providing an extended season of growth and moisture for vegetation. The sandy dunes and beaches, however, offer dry conditions with warm temperatures and shifting sands from wind and waves, limiting vegetation growth in these areas.

Project Overview

General Process

The three main components of the Sleeping Bear Dunes National Lakeshore (SLBE) vegetation mapping project are as follows: (1) vegetation classification, (2) vegetation mapping, and (3) map accuracy assessment (AA). Our objectives were to identify and map existing vegetation types of SLBE and its immediate environs.

Color-infrared (CIR) aerial photographs of the study area were collected during fall 2007, providing aerial photos for fieldwork and mapping. True-color (TC) aerial photographs were also collected during spring 2007. The scoping meeting for the SLBE vegetation mapping project was held April 24–25, 2007, at the headquarters of SLBE, in Empire, Michigan. At this meeting, primary partners met to discuss and plan the vegetation mapping project.

During the summer of 2007, botanists collected vegetation samples for plant community characterization. We entered the sampling data into the National Park Service (NPS) PLOTS Database (NatureServe 2005) and performed analyses, which provided detailed ecological information to affirm plant communities at the SLBE and document them with local descriptors. The vegetation classification was later modified with additional field reconnaissance data of SLBE, vegetation samples from other ongoing park units within the Great Lakes Network (GLKN), and data from AA sites.

Before mapping, we performed field reconnaissance throughout the summer of 2008 to correlate vegetation types to their appearances on the aerial photographs. This process ultimately resulted in the development of a map classification. An understanding of vegetation types is essential for mapping them. As vegetation concepts became known from either field or lab, we applied them to our photointerpretative mapping.

We completed a draft version of the vegetation map—a spatial database layer—for AA. During the summer of 2009, field crews collected data of stratified and randomly selected sites for evaluating the accuracy of the vegetation map layer. Results were tabulated into a contingency matrix.

Ultimately, we developed a geodatabase containing four feature classes, including the following: vegetation points (containing vegetation sampling plots and AA sites), vegetation and land cover polygons (showing locations of vegetation types and general land cover features, such as non-vegetated open water), 1:12,000-scale CIR aerial photographic centers, and project boundary extent. Included in the geodatabase are several tables providing a suite of supporting information, from classification crosswalks to detailed sampling data. All geospatial products are projected in the Universal Transverse Mercator (UTM), Zone 16, by using the North American Datum of 1983 (NAD83).

Scoping Meeting

We officially launched the mapping project with a scoping meeting held April 24–25, 2007, at the headquarters of SLBE in Empire, Michigan. Various cooperators joined together to discuss the objectives and methods of the SLBE vegetation mapping project, receive assignments, and view the landscape and vegetation of SLBE (Figure 10). Individuals from the NPS Vegetation

Inventory Program, NPS SLBE, NPS GLKN, U.S. Geological Survey Upper Midwest Environmental Science Center, and NatureServe met to achieve the following objectives:

- Inform SLBE staff of the classification and mapping project,
- Learn about management and science issues and concerns at the SLBE,
- Learn about existing data,
- Explore possible cooperation with neighbors and partners,
- Develop an action plan for vegetation classification and mapping, and
- Define project boundary.



Figure 10. Participants of the scoping meeting viewing, firsthand, vegetation types at the Sleeping Bear Dunes National Lakeshore, Michigan.

Project Boundary Extent

The project boundary extent for the SLBE vegetation mapping project includes the entire administrative boundary for SLBE, plus an additional 400 m of environs beyond, which includes 400 m of surface water jurisdiction into Lake Michigan (Figure 11). The total map extent is 33,740.7 ha, including all SLBE administrative lands, surface water jurisdiction, in-holdings, and extended environs. We produced a feature-class layer showing the extent of the project boundary and incorporated it into the geodatabase for the SLBE vegetation mapping project.

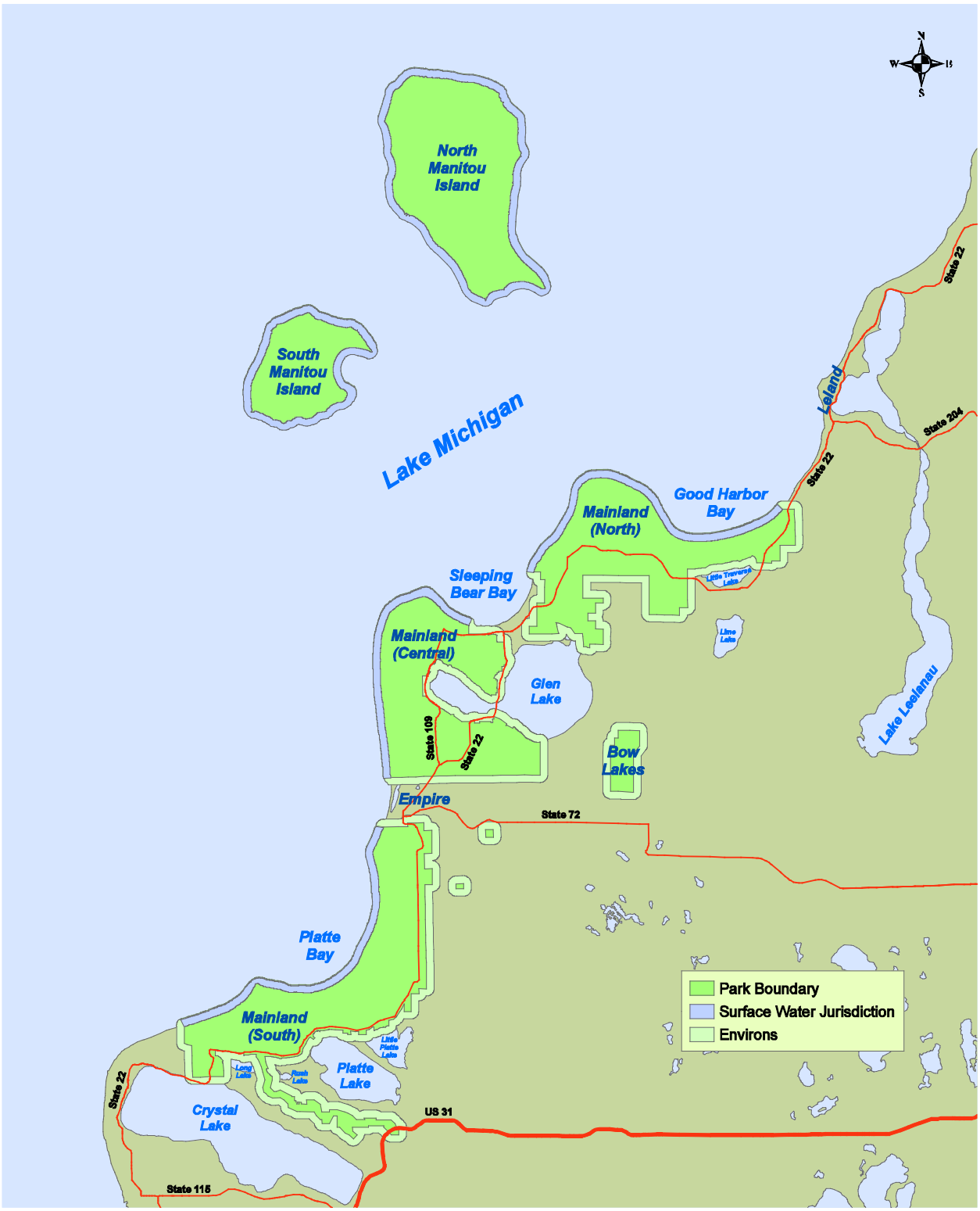


Figure 11. Project boundary for the Sleeping Bear Dunes National Lakeshore (Michigan) vegetation mapping project.

Aerial Photography

Aerial photographs provide the baseline imagery data for mapping vegetation types and other feature units. Vertical photographs (photographs taken with the aerial camera pointed straight down at the ground) collected with proper overlapping within each flight line permit an interpreter to study the photographs three-dimensionally with a stereoscope (Avery 1978). Because ecologic settings are taken into account in mapping vegetation types, the ability to view aerial photographs in this way is fundamental.

A variety of film emulsions from which to choose is available, and Avery (1978) concludes that no single film emulsion serves all purposes. Our aim with collecting aerial photography for the SLBE vegetation mapping project was to capture peak leaf-color change, aiding mapping in viewing distinctions between various deciduous forest types.

A set of 1:12,000-scale CIR aerial photographs was collected on October 20, 2007 (funded by the NPS Vegetation Inventory Program (VIP), and the photo mission was supervised by GLKN staff). This set of photography was the primary imagery used in photointerpretative mapping. In addition to the CIR photos, a set of 1:12,000-scale TC aerial photographs were collected April 22, 2007, providing deciduous leaf-off viewing. This photo mission was funded and supervised by GLKN staff. Having the TC photos gave interpreters a definite advantage in determining evergreen tree and shrub components within forest communities that are otherwise obscured by deciduous tree canopy on the fall-season CIR photos, thus giving credence to Avery's (1978) statement regarding lack of a single all-purpose film emulsion. Table 4 gives details of the aerial photography acquired for the SLBE vegetation mapping project.

Table 4. Aerial photography sets for the Sleeping Bear Dunes National Lakeshore vegetation mapping project.

[CIR, color-infrared; TC, true-color]

Photography date	Film type	Scale	Products	Company
October 20, 2007	CIR Transparency (Positive)	1:12,000	Contact Print Diapositive Orthophotograph	AlliedGIS (Pinnacle Mapping, subcontractor)
April 22, 2007	TC Transparency (Positive)	1:12,000	Contact Print Orthophotograph	AlliedGIS (Pinnacle Mapping, subcontractor)

To assure stereo viewing and full aerial coverage, aerial photo missions were planned with a 60% forward-lap and 30% side-lap. Contact prints of both CIR and TC sets were produced for fieldwork use by mappers and vegetation crews. Diapositives of the CIR set were produced for photointerpretative mapping.

We produced a feature-class layer locating the centers of the CIR aerial photographs (1:12,000-scale) obtained in October 2007 (Figure 12). This feature class is incorporated into the geodatabase for the SLBE vegetation mapping project. In addition, a digital orthophotographic mosaic of both the CIR and TC aerial photographs has been produced by the aerial photo contractor.

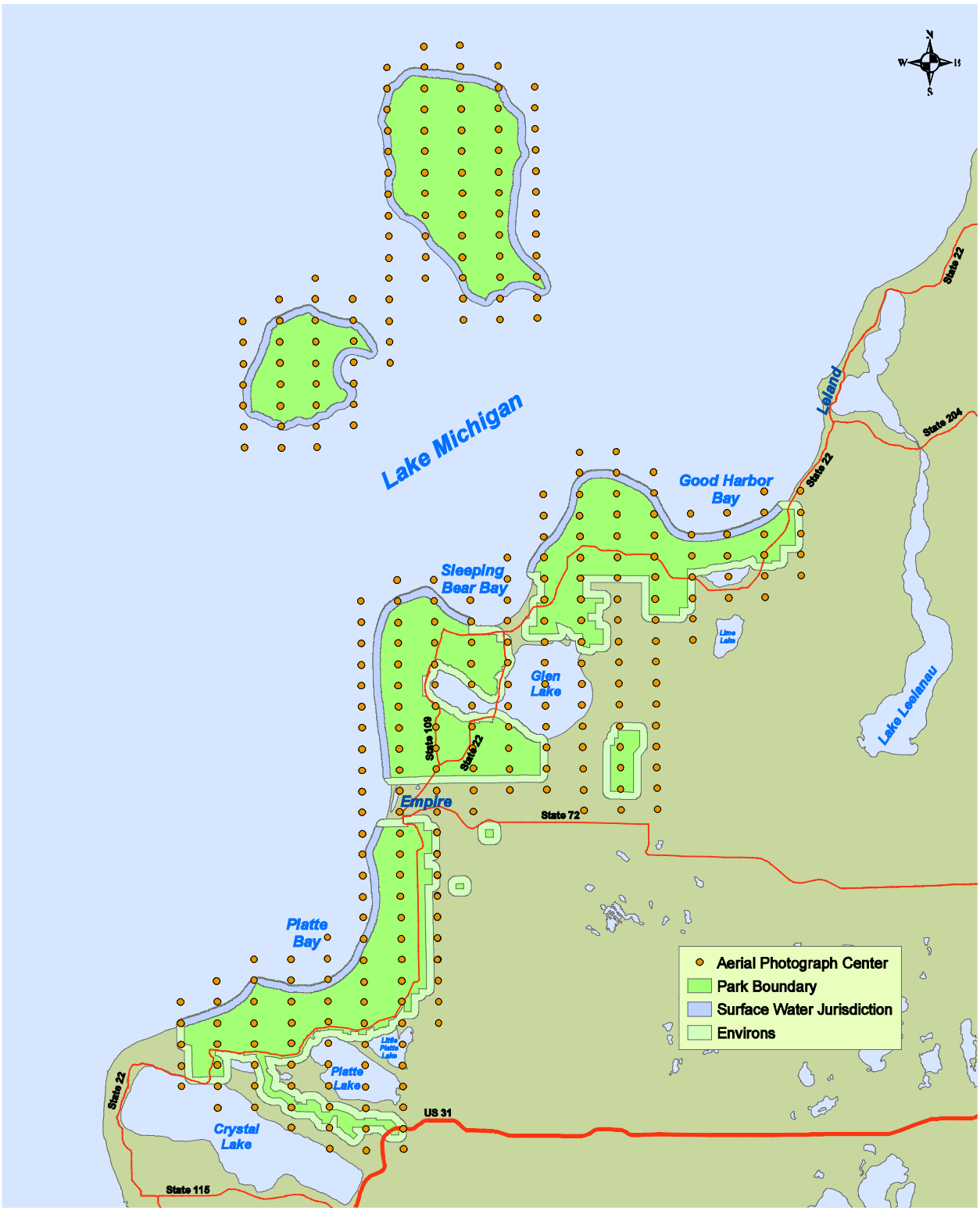


Figure 12. Centers of color-infrared aerial photographs (1:12,000-scale) obtained in October 2007 for the Sleeping Bear Dunes National Lakeshore (Michigan) vegetation mapping project.

Minimum Mapping Units

We applied the NPS VIP standard minimum mapping unit (MMU) of 0.5 ha for mapping. For vegetation types unique to their immediate surroundings (e.g., emergent wetland within an upland forest setting), we allowed for mapping below the MMU down to 0.25 ha. In addition, we applied a secondary MMU of 2.0 ha for physiognomic feature changes within a particular map class (e.g., open versus closed canopy). We used MMU templates to help us determine minimum polygon size on the photographs during mapping. Because of angle distortions inherent to nonrectified aerial photos, and slight scale changes from high ridges to valley bottoms, we applied our MMU standards liberally.

Classification Organization

Throughout this project report and the final products related to the SLBE vegetation mapping project (e.g., the geodatabase), we have organized the vegetation classification with the National Vegetation Classification Standard (NVCS), Version 2 (FGDC 2008). In the NVCS, separate categories are provided for natural and cultural vegetation. Typically, areas having 1% or more of their surface area with live vegetation cover are classified within the NVCS. The NVCS excludes non-vegetated natural lands (e.g., sand beaches) and waters (e.g., lakes, rivers). For these, we employ the classification provided by the 2001 National Land Cover Database (Homer et al. 2004).

Throughout this report, the term “vegetation type” is used to reference vegetation classification units in general, at any level of the hierarchy within the NVCS. For example, the Northern Hardwood - Hemlock - White Pine Forest Group and the *Alnus incana* Swamp Shrubland Association are both treated as vegetation types. Furthermore, the term “floristic level” (or similar use) is used to describe collectively the two natural/semi-natural lower levels (association and alliance) of the NVCS.

Vegetation Classification

Methods

Preliminary Classification

The first step in classifying the vegetation of Sleeping Bear Dunes National Lakeshore (SLBE) was to prepare a preliminary classification report prior to the April 2007 scoping meeting. This report for the SLBE area was generated by reviewing all floristic (association and alliance) vegetation types in the National Vegetation Classification Standard (NVCS) attributed to Michigan in the Great Lakes Ecoregion (ECO48 of The Nature Conservancy's ecoregional classification). This listing of floristic types covered a much broader area than the SLBE project area, including many vegetation types that were very unlikely to occur there. This initial list of floristic types was reviewed by NatureServe and SLBE staff to remove vegetation types thought unlikely to occur at SLBE. The resulting preliminary classification report included 73 associations thought to possibly occur at SLBE. The list of associations from this report served as a rough guide to the number and kind of associations the field crew might encounter during vegetation plot sampling and helped us to estimate how much data field crews would need to collect to adequately survey the project area.

Data Collection Preparation

The protocols for the National Park Service (NPS) Vegetation Inventory Program (VIP) allow for the collection of approximately three plots per estimated association type (from the preliminary classification report), on average. The preliminary classification listed 73 possible associations in the project area. Several of those were similar to each other, though, and we expected only one or two of those to actually be present in the project area. For example, we knew there would be upland eastern hemlock (*Tsuga canadensis*) or hemlock-hardwood forests in the project area. There were four associations in these groups listed in the preliminary classification. We did not know which of those would best fit the data we would gather from the project area, but we suspected that the data would best fit one, two, or, at most, three of those four. So, although we had four upland hemlock and hemlock-hardwood forest types in the preliminary classification, we estimated that we would need only six plots to adequately characterize those forest types. We did similar analyses for all associations in the preliminary classification and estimated there would be approximately 42 unique vegetation associations at SLBE. Thus, our initial plan was to sample at least 126 plots.

Some vegetation types in the preliminary classification (e.g., conifer and conifer-hardwood swamps) were less well described or expected to have variable composition from stand to stand, so we targeted 3–5 plots for them. Other types (e.g., beaches, water-lily marshes) were well described and/or compositionally simpler; therefore, we targeted 1–3 plots for those. We looked into using existing data to supplement our plots or to reduce our data collection needs but did not find any suitable data. Existing data from monitoring plots within SLBE existed; however, the sampling sites were too small to be useful for our purposes.

All field sampling was done within the boundaries of SLBE. In attempting an inventory of vegetation communities at SLBE, we faced the problem of finding every vegetation type at SLBE without knowing where they all were or even exactly what they all were. Limited time available for field work prohibited extensive reconnaissance. Instead, we used available GIS

layers, the preliminary vegetation classification, consultation with knowledgeable staff at SLBE, and the experience of the field crew to guide our sampling effort. Available to us was an existing vegetation map. Although this map was not very accurate and its units were ad-hoc, it did serve to give us an idea of where general habitats were. We were able to identify swamps, bogs, deciduous uplands, dunes, etc. We sent the crews to all of these habitats with the idea that in surveying the range of general habitats they would be likely to find the fine-scale, association-level vegetation units. By using the preliminary vegetation classification, they were able to understand what an association-level unit was and the characteristics of many of the existing ones that we suspected would be on the landscape. As the field crew learned more about the vegetation landscape at SLBE and consulted with staff, they were able to locate less common vegetation types.

Field Sampling

The field sampling methodology was adapted from program standards (NatureServe 2004). Details are provided therein, with a general summary here.

Plots were placed to represent the character of an entire stand of vegetation as well as possible. Plots were usually located at least 15 m from the boundary of another vegetation type to reduce the variability associated with the transition from one vegetation type to another. This was not always possible in the case of small or linear vegetation stands. It was sometimes difficult to determine what constituted the boundary of a unique vegetation type because two adjacent stands may be floristically very similar but separated in the NVCS based on physiognomic criteria (e.g., amount of shrub cover, which may be determined by one or two species).

Plots were square or rectangular and were either 100 or 400 m^2, depending on the dominant physiognomy (Table 5). Boundaries of the plots were marked with flagging or with measuring tapes.

Table 5. Plot sizes used for vegetation plot sampling for the Sleeping Bear Dunes National Lakeshore (Michigan) vegetation mapping project.

Dominant physiognomy	Plot size	Plot area
Forest: trees have their crowns overlapping, usually forming 60–100% cover.	20 x 20 m or 40 x 10 m	400 m^2
Woodland: open stands of trees with crowns usually not touching. Canopy tree cover 25–60%, OR exceeds shrub, dwarf-shrub, herb, and nonvascular cover.	20 x 20 m or 40 x 10 m	400 m^2
Shrubland: shrubs greater than 0.5 m tall are dominant, usually forming more than 25% cover OR exceeding tree, dwarf-shrub, herb, and nonvascular cover.	10 x 10 m or 20 x 5 m	100 m^2
Dwarf-shrubland (e.g., heath): Shrubs less than 0.5 m tall are dominant, usually forming more than 25% cover OR exceeds tree, shrub, herb, and nonvascular cover.	10 x 10 m or 20 x 5 m	100 m^2
Herbaceous (e.g., grassland, meadow, marsh): Herbs dominant, usually forming more than 25% cover OR exceeds tree, shrub, dwarf-shrub, and nonvascular cover.	10 x 10 m or 20 x 5 m	100 m^2
Nonvascular (e.g., fen, bog, cliff): nonvascular cover dominant, usually forming more than 25% cover.	10 x 10 m or 20 x 5 m	100 m^2
Sparse vegetation (e.g., blowout, beach): less than 10% total vegetation cover.	10 x 10 m or 20 x 5 m	100 m^2

Within each plot, the vegetation was visually separated into strata. The canopy cover and average height of each stratum was estimated. Within each stratum, all taxa within the plot area were

identified, and the foliar cover of each taxon was estimated by using cover classes. (See Table 6 for cover classes and strata.) The diameter at breast height (DBH) of trees greater than 10 cm width was recorded as well.

Table 6. Cover classes and vegetation strata used during vegetation plot sampling for the Sleeping Bear Dunes National Lakeshore (Michigan) vegetation mapping project.

Cover scales		Vegetation strata	
T	0–1%	T1	Emergent Canopy:
P	>1–5%	T2	Main Canopy
1	>5–15%	T3	Subcanopy
2	>15–25%	S1	Tall Shrubs
3	>25–35%	S2	Short Shrubs
4	>35–45%	S3	Dwarf-shrubs
5	>45–55%	H	Herbaceous (field layer, including tree seedlings)
6	>55–65%	A1	Floating-leaved aquatics
7	>65–75%	A2	Submerged-leaved aquatics
8	>75–85%		
9	>85–95%		
10	>95%		

Environmental information, such as slope, aspect, soil texture, and evidence of disturbance, were recorded. Locational information, including spatial coordinates, was obtained by using a global positioning system (GPS), and written directions to the plot were provided. Digital photographs were taken of the plot to provide additional information and to assist in classifying the plot. Finally, the field crew gave the plot a provisional classification name. Figure 13 shows an example of a vegetation plot. For an example of a plot form, see Appendix A: Plot Sampling Form.



Figure 13. Example of a vegetation plot at Sleeping Bear Dunes National Lakeshore, Michigan.

Data Analyses, Results, and Discussion

Field teams collected plot information and data from mid-June through August 2007, sampling 120 plots across the mainland, South Manitou Island, and North Manitou Island (Figure 14). All field data were entered into the NPS PLOTS Database Version 2.0, a Microsoft Access database designed for the NPS VIP (NatureServe 2005b).

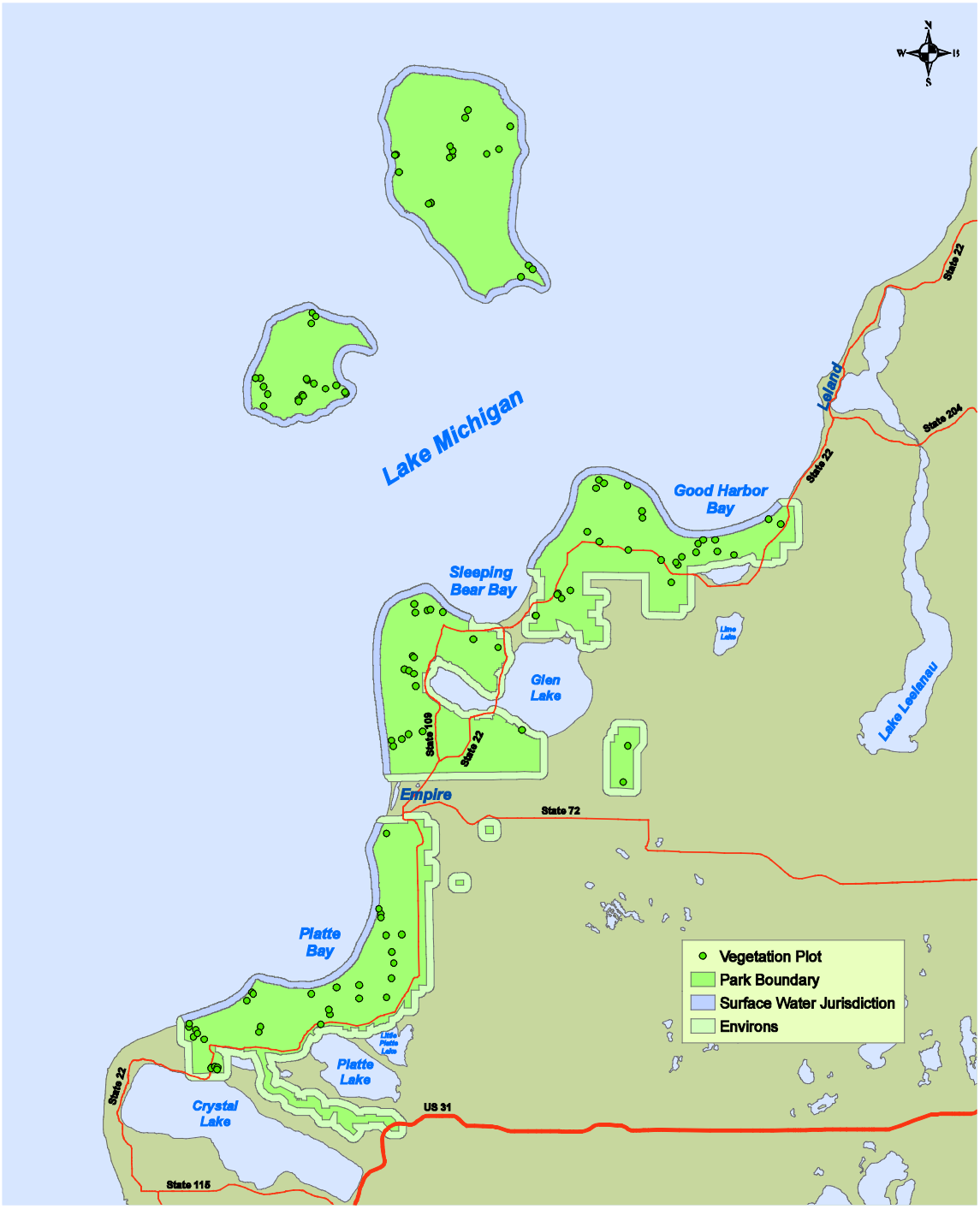


Figure 14. Locations of the 120 vegetation plots sampled for the Sleeping Bear Dunes National Lakeshore (Michigan) vegetation mapping project.

To analyze vegetation patterns and classify types, we partitioned the plot data by using non-metric multi-dimensional scaling (NMS) ordination and flexible beta clustering techniques with PC-ORD 5.0 software (McCune and Mefford 1999). Potential groupings of plots were also compared by using indicator species.

Our quantitative analyses proceeded iteratively, starting with the entire data set, deriving a few groups, and then repeating the process on each new group until we ended up with sets of plots that matched the scale of an association in the NVCS. At SLBE, the initial split was between upland plots and wetland plots. Each of these groups was subsequently divided into forests and woodlands versus shrublands and herbaceous vegetation (Figure 15). After that, we began separating groups of plots at the association scale. Each association could be represented by one to several plots. Dominant canopy species were of primary importance in dividing the forest types, and understory species helped parse those types into associations. In order to better inform the results of the ordination and cluster analyses, the constancy and frequency of all the overstory and understory species associated with all the plots in each grouping were calculated. These aspects of the vegetation helped to further characterize and differentiate the forest types for those that were highly variable. Shrublands and herbaceous plots were distinguished by using NMS ordination and flexible beta clustering, along with using dominant species. We used the ordination and cluster analyses to show which plots grouped together and we used the dominant species to help establish a link between the plot groups at SLBE and existing associations in the NVCS.

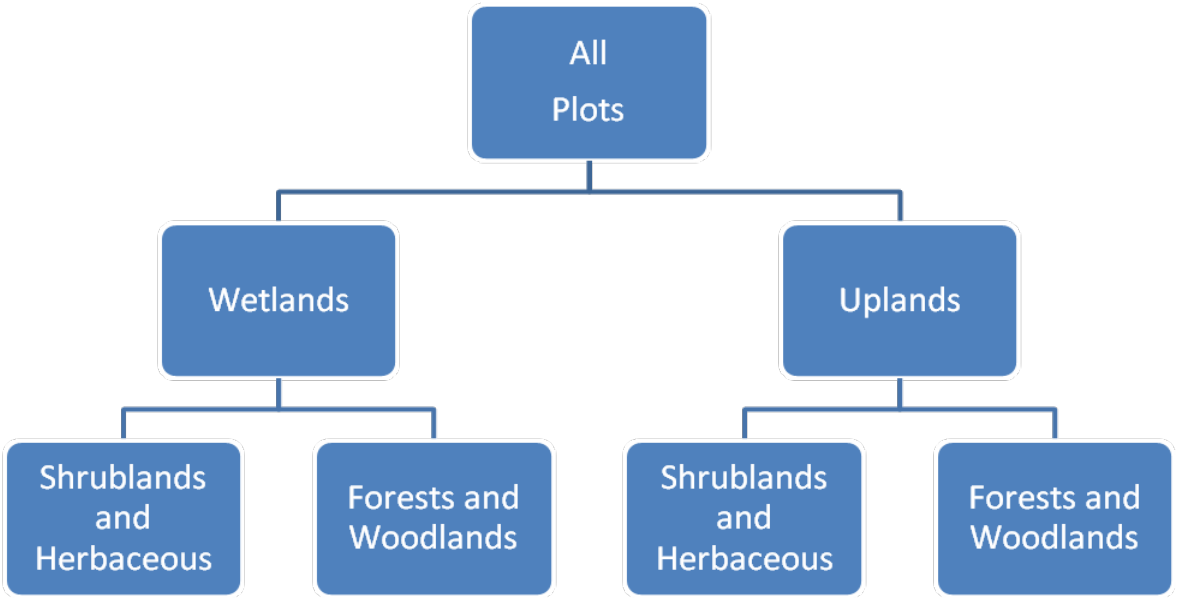


Figure 15. General vegetation groups as defined by cluster and ordination analyses for the vegetation classification of the Sleeping Bear Dunes National Lakeshore, Michigan.

By using the results of both NMS and Flexible Beta analyses, classification rules were generated to assign plots to associations or alliances. Typically, those stands that had 25–75% cover from hardwoods in the canopy were considered a mixed forest and were assigned based on the dominant conifer in the canopy. Those stands that had <25% canopy cover from hardwoods were assigned based on the dominant conifer; those with <25% canopy cover from conifer species

were assigned based on the mixture of hardwoods found in the canopy. These rules were also applied during the mapping of NVCS types.

Through the analyses of our summer 2007 sampling plots, we identified 40 plant communities (associations in the NVCS), with each association type having an average of three plots. Individual association types had plots ranging from one to 12. Rare and/or least variable associations tended to have the fewest plots, while the most common and/or most variable types had the most. For example, one-quarter of all plots were in three widespread and somewhat variable association types. Their variability is summarized below:

- Great Lakes Beachgrass Dune (12 plots): physiognomically variable from sparse to dense herbaceous vegetation, sometimes with scattered trees or shrubs; usually dominated by one or a combination of American beachgrass (*Ammophila breviligulata),* prairie sandreed (*Calamovilfa longifolia),* and little bluestem (*Schizachyrium scoparium);* sometimes with significant field sagewort (wormwood) (*Artemisia campestris)* or sand dune thistle (Pitcher's thistle) (*Cirsium pitcheri).*
- Beech - Maple - Northern Hardwoods Forest (10 plots): sometimes physiognomically variable with conifers present; floristic variability in the relative cover of red maple (*Acer rubrum),* sugar maple (*Acer saccharum),* and American beech (*Fagus grandifolia)* and in the amount of associated canopy species, including white ash *(Fraxinus americana),* northern red oak (*Quercus rubra),* and American basswood (*Tilia americana).*
- White-cedar - Boreal Conifer Mesic Forest (7 plots): physiognomically variable from open to closed forest; always with significant amounts of northern white-cedar (*Thuja occidentalis)* but floristically variable in the amount of associated species, including balsam fir (*Abies balsamea),* sugar maple (*Acer saccharum),* and pine (*Pinus* spp.).

During our summer 2008 field reconnaissance for the mapping effort, we discovered other vegetation types that had not been characterized by the plot data. An additional 11 floristic vegetation types (10 associations and 1 alliance) were defined from informal field data and aerial photo study, and the addition was eventually supported with data from field accuracy assessments (AA) collected in 2009 (Table 7). These vegetation types were well described from a regional perspective, so assigning them to an association or alliance type was fairly straightforward, even without full vegetation plots. The composition and location of these vegetation types were often well known to the staff working on this project.

Five of these 11 vegetation types identified from the 2008 field season are forest wetland associations, and another type is a shrub wetland association. It is likely that the difficulty in surveying large wetlands on foot led the field crews in 2007 to undersample the diversity of wooded wetlands. In 2008, we were able to visit and explore considerably more locations of SLBE during the field reconnaissance for mapping (including the interior of swamps and fens). Having aerial photographs in hand assisted us in locating vegetation units that looked different from vegetation types already identified.

The other five vegetation types identified from the 2008 field season are upland forests and woodlands consisting of three pine forest associations, a spruce-fir-hardwood forest association with boreal affinities, and a floristically and physiognomically diverse woodland alliance that tended to occur on the border between open dunes toward Lake Michigan and closed forests inland.

Table 7. List of floristic vegetation types of Sleeping Bear Dunes National Lakeshore (Michigan) that were identified after vegetation-plot data collection in 2007.

[NVCS, National Vegetation Classification Standard; CEGL, Community Element Global; A., Alliance]

Association Name*	NVCS Code
Jack Pine - Northern Pin Oak Forest	CEGL002478
Red Pine - Aspen - Birch Forest	CEGL002520
Red Pine / Blueberry Dry Forest	CEGL002443
Red Maple - Ash - Birch Swamp Forest	CEGL002071
Central Tamarack Poor Swamp	CEGL002472
White Pine - Red Maple Swamp	CEGL002482
Spruce - Fir - Aspen Forest	CEGL002475
Northern Tamarack Rich Swamp	CEGL002471
White-cedar - (Mixed Conifer) / Alder Swamp	CEGL002456
Eastern Cottonwood Woodland Alliance	A.1493
Leatherleaf - Sweetgale Shore Fen	CEGL005228

*Unless otherwise specified.

The spatial patterns and transitions among the upland forest and woodland types that we identified based on 2008 field work highlight some of the more complicated areas encountered while classifying the vegetation of SLBE. The transition from open dunes near Lake Michigan to closed mesic or dry-mesic forests inland was quite complex in some areas. This seemed most evident in the southern end of SLBE, near Platte Bay, and to a lesser extent in some areas near Good Harbor Bay. Just inland from the open dunes or dune shrublands, there was often a band of Great Lakes Dune Pine Forest. Continuing inland, one of the several dry to dry-mesic forests occur, which are dominated by some combination of eastern white pine (*Pinus strobus*), red pine (*Pinus resinosa*), and jack pine (*Pinus banksiana*) with or without northern red oak (*Quercus rubra*), white oak (*Quercus alba*), quaking aspen (*Populus tremuloides*), and red maple (*Acer rubrum*). At SLBE, these dry to dry-mesic forests would fall into one of the six association types in the White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group. There were differences in the understory of some of these associations, but they were neither consistent enough nor large enough to always differentiate them from each other. For the vegetation classification and the mapping rules, we differentiated these types based largely on the relative proportions of the canopy trees, though we added understory species and abiotic variables where possible. Thus, it was often the case that we had to estimate the relative cover of one or two pine species versus that of aspen and red maple versus that of red oak to decide how to classify a stand. In borderline cases, a slight variance in the estimate of cover by one or two important taxa would result in a difference in how the stand was classified. The impact of variance in measuring metrics in borderline cases is a general problem when classifying vegetation, but this group of dry to dry-mesic forests at SLBE had more possibilities for classification based on slight differences than is commonly the case.

It is worth noting that the Spruce - Fir - Aspen Forest association at SLBE has boreal affinities uncommonly found as far south as SLBE. This forest type was found nearly always on North and South Manitou Islands, presumably because of the cooling effect of the lake during the summer.

In all, a total of 51 natural/semi-natural floristic vegetation types (50 associations and one alliance) from the NVCS were identified for SLBE. Table 8 lists the vegetation types and includes the number of times each type was sampled within a vegetation plot or an AA site. (Note that some AA sites were assigned at the group level of the NVCS and do not appear in Table 8.) It is also worth noting that there were over eight times as many AA sites sampled than vegetation plots (1,024 vs. 120); most of the field observations were from AA sites. Data from AA sites provide important information on distribution and dominant species but do not have the detail of a full vegetation plot. Also, two vegetation plots were not used in the quantitative vegetation classification. These plots were collected in old fields that do not fit into the natural/semi-natural floristic levels of the NVCS, but rather fit into the group level.

For other types above the floristic vegetation level of the NVCS (e.g., group), we relied on general observations via studies from the field and of aerial photos to determine placement in the NVCS. These types characterize human or natural disturbance regimes (e.g., ruderal herbaceous field, dynamic beaver meadow).

Table 8. List of floristic vegetation types of Sleeping Bear Dunes National Lakeshore (Michigan), with number of field observations.

[NVCS, National Vegetation Classification Standard; CEGL, Community Element Global; A., Alliance]

Group	Association Name*	NVCS Code	Observations
Forest & Woodland Class			
North-Central Beech - Maple - Basswood - Oak Forest Group			
	Beech - Maple - Northern Hardwoods Forest	CEGL005004	54
Great Lakes Pine Barrens Group			
	Great Lakes Dune Pine Forest	CEGL002589	19
White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group			
	Jack Pine - Northern Pin Oak Forest	CEGL002478	14
	Red Pine - Aspen - Birch Forest	CEGL002520	26
	Red Pine / Blueberry Dry Forest	CEGL002443	31
	White Pine - Red Oak Forest	CEGL002480	57
	White Pine - Aspen - Birch Forest	CEGL002479	40
	White Pine / Blueberry Dry-Mesic Forest	CEGL002444	17
Northern Hardwood - Hemlock - White Pine Forest Group			
	Sugar Maple - Ash - Basswood Northern Rich Mesic Forest	CEGL005008	36
	Aspen - Birch - Red Maple Forest	CEGL002467	32
	Northern Red Oak - Sugar Maple Forest	CEGL002461	31
	White-cedar - Boreal Conifer Mesic Forest	CEGL002449	47
	Hemlock Mesic Forest	CEGL002598	25
	Great Lakes Hemlock - Beech - Hardwood Forest	CEGL005042	34
Northern & Central Alkaline Conifer & Hardwood Swamp Group			
	Red Maple - Ash - Birch Swamp Forest	CEGL002071	36
	Black Ash - Mixed Hardwood Swamp	CEGL002105	37
	Central Tamarack Poor Swamp	CEGL002472	3
	White Pine - Red Maple Swamp	CEGL002482	6
	White-cedar - Black Ash Swamp	CEGL005165	34
	Hemlock - Yellow Birch Swamp Wet-Mesic Forest	CEGL005003	9

Group	Association Name*	NVCS Code	Observations
Northern & Central Shrub Swamp Group			
	Gray Alder Swamp	CEGL002381	56
Jack Pine - Black Spruce Forest Group			
	Jack Pine / Blueberry / Feathermoss Forest	CEGL002441	20
White Spruce - Balsam Fir Forest Group			
	Spruce - Fir - Aspen Forest	CEGL002475	3
Eastern Black Spruce - Tamarack Acidic Swamp Group			
	Black Spruce - Tamarack / Labrador-tea Poor Swamp	CEGL005271	6
Eastern Tamarack - Conifer Alkaline Swamp Group			
	Northern Tamarack Rich Swamp	CEGL002471	5
	White-cedar - (Mixed Conifer) / Alder Swamp	CEGL002456	8
Shrubland & Grassland Class			
Northern & Central Sand Barrens Group			
	Bracken Grassland	CEGL005142	8
Eastern North American Lake Flat & Beach Group			
	Inland Freshwater Strand Beach	CEGL002310	3
Great Lakes Dune Grassland & Shrubland Group			
	Great Lakes Beachgrass Dune	CEGL005098	50
	Great Lakes Beach	CEGL005162	22
	Interdunal Wetland	CEGL005105	7
	Great Lakes Juniper Dune Shrubland	CEGL005064	40
	Great Lakes Coast Pine Barrens	CEGL005125	34
	Eastern Cottonwood Woodland Alliance	A.1493	9
	Cottonwood Dune Open Woodland	CEGL005119	29
	Sand Cherry Dune Shrubland	CEGL005075	24
Eastern North American Boreal Acidic Bog & Poor Fen Group			
	Leatherleaf Poor Fen	CEGL005277	19
Eastern North American Boreal Alkaline Fen Group			
	Great Lakes Sedge Rich Shore Fen	CEGL005115	25
	Woolly-fruit Sedge Shore Fen	CEGL005229	15
	Leatherleaf - Sweetgale Shore Fen	CEGL005228	3
	Shrubby-cinquefoil - Sweetgale Rich Shore Fen	CEGL005275	5
Atlantic & Gulf Coastal Plain Pondshore & Wet Prairie Group			
	Inland Coastal Plain Marsh	CEGL005108	5
Northern & Central Ruderal Wet Meadow & Marsh Group			
	Eastern Reed Marsh	CEGL004141	6
Eastern North American Freshwater Marsh Group			
	Northern Great Lakes Emergent Marsh	CEGL005274	31
	Midwest Mixed Emergent Deep Marsh	CEGL002229	14
Eastern North American Wet Meadow Group			
	Bluejoint Wet Meadow	CEGL005174	27
	Northern Sedge Wet Meadow	CEGL002257	23
	Upright Sedge Wet Meadow	CEGL002258	3
	Dogwood - Willow Swamp	CEGL002186	25
Aquatic Vegetation Class			
Eastern North American Freshwater Aquatic Vegetation Group			
	Northern Water-lily Aquatic Wetland	CEGL002562	8
	Midwest Pondweed Submerged Aquatic Wetland	CEGL002282	5

*Unless otherwise specified.

All floristic vegetation types within the NVCS (mostly association, one alliance) that we identified at the SLBE are described in Appendix B: Descriptions of Vegetation Types. A key to vegetation types is provided in Appendix C: Field Key to Vegetation Types, which can be used in concert with the vegetation descriptions. A listing of plant species identified from the vegetation plot samples and AA sites are provided in Appendix D: List of Plant Species.

Vegetation Mapping

Methods

Mapping vegetation of Sleeping Bear Dunes National Lakeshore (SLBE) and environs involved five primary steps, including the following: (1) preliminary map classification (2) field reconnaissance, (3) map classification, (4) photointerpretation, and (5) digital map automation and database development. Although these steps occurred sequentially, they overlap to some degree.

Preliminary Map Classification

Prior to field reconnaissance, it is advantageous for photointerpreters to become familiar with any known vegetation types to be mapped. Having a map classification in hand with initial mapping conventions, as preliminary as it might be, promotes continuity from the classifier to the mapper at the onset of the vegetation mapping process. Additionally, this preliminary step puts in the hands of the photointerpreters the foundations of a working map classification, one that will undoubtedly go through many updates and revisions throughout the vegetation mapping process.

By the spring of 2008, the vegetation classification for SLBE had been developed via analyses of the vegetation sampling data collected the prior year. Thus, we met as classifiers and mappers in Redwing, Minnesota, during May 2008 to discuss the vegetation classification and how vegetation types might best be represented in a workable map classification. Pertinent details about the vegetation types that might aid in making interpretive decisions were assembled into mapping conventions.

Field Reconnaissance

In preparation to map vegetation types, we spent several days in the field investigating ground conditions and comparing them to the set of color-infrared (CIR) aerial photographs (the set of photos acquired for photointerpretative mapping). This process is necessary, as Hershey and Befort (1995) explain, because CIR photography is not consistent enough between photo sets to allow a species to be described precisely. Film batch, printing process, sun angle, light intensity, shadow, and exposure can all affect the appearance. Hence, in spite of our experience as photointerpreters, we engaged in ground verification of the aerial photographs. Ultimately, field reconnaissance helped us correlate photo signatures of the vegetation (appearances of vegetation on the aerial photographs) to vegetation on the ground (Figure 16).

Field reconnaissance also allowed photointerpreters to become more familiar with the local ecology of vegetation types, which is always important when applying ecologic concepts to photointerpretative mapping. Where photointerpreters discovered limitations to interpreting vegetation types by using aerial photographs, environmental models were tested (e.g., soil) to determine if vegetation types could be consistently separated by environmental elements.

We performed our field reconnaissance throughout the summer of 2008. Much of this effort was accomplished as a team of mappers and ecologists to ensure correct assessment of vegetation types and, subsequently, to promote correct assignment during photointerpretative mapping. We became familiar with the vegetation and local ecology as we discussed the structural, floristic, and habitat characteristics of the vegetation encountered in the field and compared them to their

appearance on the photos. Through this process, we built an understanding of how to map the vegetation types and established a working map classification with mapping protocols.



Figure 16. Field reconnaissance to correlate aerial photo signatures to ground vegetation.

The photo contact prints were taken into the field, with notes recorded onto photo jackets. Field notes might consist of the map-class assignment, if known. Other notes, to promote proper perspective of species composition (e.g., heterogeneous versus monotypic forest stand), might include comments regarding significant species. In essence, we would build a photo signature and environmental model on which to base our decisions during photointerpretative mapping. In addition, estimated tree heights were occasionally recorded to give a perspective for applying the physiognomic height modifier during mapping.

Map Classification

The map classification and protocols are based on existing classification systems. A map class represents a definable feature (e.g., a vegetation type) that can be distinguished on an aerial photograph and/or by use of an environmental model. We linked map classes representing natural/semi-natural vegetation types to the floristic levels (association or alliance) in the National Vegetation Classification Standard (NVCS), Version 2 (FGDC 2008), as identified by NatureServe. Some vegetation types could not be assigned to an association- or alliance-level type because of disturbance (e.g., human or beaver activities). For those map classes, we assigned the appropriate group-level type further up the hierarchy in the NVCS. Cultural vegetation (e.g., roads, residence, parks) were linked to the upper echelon of the NVCS and then further described with special modifiers by using the classification from the National Land Cover

Database (NLCD) 2001 (Homer et al. 2004).[1] For non-vegetation features (e.g., open water bodies), we derived map classes corresponding closely with the classification from NLCD 2001.

For those map classes representing association types in the NVCS, we used synonym names established in the classification database of NatureServe (e.g., Great Lakes Hemlock - Beech - Hardwood Forest). For alliance types, we used the direct translation to the scientific name within the database of NatureServe, followed by a more descriptive name in parenthesis; e.g., Eastern Cottonwood Woodland (Paper Birch Coastal Dune Woodland). For map classes with phases, we used the synonym names, followed by, and in parenthesis, the phase name we derived, such as Great Lakes Coast Pine Barrens (barrens phase). We developed map-class phases when a variation of the plant community was recognizable on the aerial photographs and had importance for either management or ecologic interests. For map classes representing types above the floristic level in the NVCS and for non-vegetation features, we derived generic names to describe the feature.

We continually updated the map classification throughout the mapping effort. Each field endeavor revealed new information, prompting us to modify map classes and their definitions. We also made revisions as the vegetation classification developed to completeness. Furthermore, as aerial photos were interpreted, new issues arose, which forced us to redefine, expand, or polish map-class definitions. Throughout the project, we adjusted the map classification as needed to best reflect the vegetation classification we knew at the time.

We derived a map-class code for each map class merely for ease of assigning information to map polygons and as a short-hand language amongst team members. For each polygon, a map-attribute code is assigned, which is a code constructed of the following two sections: (1) a single map-class code and (2) a set of physiognomic modifier codes. A hyphen separates the two code systems (e.g., [map-class code]-[set of physiognomic modifier codes]).

A map class code is made up of three alpha characters and represents an independent map class. Each map-class code begins with the first alpha representing the major physiognomic characteristic, as follows:

- F = Forest,
- W = Woodland,
- S = Shrubland,
- H = Herbaceous Vegetation,
- V = Sparse Vegetation,
- C = Cultural Developed, and
- N = Non-NVCS.

The subsequent two alpha characters for each map class loosely represent the map-class name (e.g., AS for alder swamp, WM for wet meadow, DV for developed).

The physiognomic modifier codes are strings of alpha and numeric characters and, when applicable, follow the map-class codes. These physiognomic modifiers provide additional

[1] The NLCD 2001 is a land cover database produced by the Multi-Resolution Land Characterization 2001 Consortium.

information describing the physiognomic characteristics of the vegetation within each mapped polygon. Table 9 lists the physiognomic modifiers we used for mapping the SLBE.

Table 9. Physiognomic modifiers assigned to polygons during photointerpretation for the Sleeping Bear Dunes National Lakeshore (Michigan) vegetation mapping project.

Category	Modifier	Meaning
Coverage density (Applied to all vegetation map classes)	1	Closed Canopy/Continuous (60–100% cover)
	2	Open Canopy/Discontinuous (25–60% cover)
	3	Dispersed-Sparse Canopy (10–25% cover)
Coverage pattern (Applied to all vegetation map classes)	A	Evenly Dispersed
	B	Clumped/Bunched
	C	Gradational/Transitional
	D	Regularly Alternating
Height (Applied to woody terrestrial vegetation map classes only)	2	15–30 m
	3	5–15 m
	4	0.5–5 m
	5	<0.5 m

An example of a map-attribute code is "FCM-1A3." This code describes given map polygons as the conifer - hardwood phase (FCM) of the map class White-cedar - Boreal Conifer Mesic Forest, which represents the *Thuja occidentalis* / *Abies balsamea - Acer spicatum* Forest Association (CEGL002449) in the NVCS. This code also indicates that the vegetation has a coverage density of 60–100%, a coverage pattern that is evenly distributed, and an average tree height of 5–15 m throughout the mapped polygon. Presenting this series of map classification and physiognomic information can greatly enhance the interpretation of the map layer for managers and researchers, particularly when introducing other geospatial data sets.

Photointerpretation

Preparation of the aerial photographs for interpretation generally followed procedures of Owens and Hop (1995). We placed clear acetate overlays on each aerial photograph diapositive used for mapping. Using the diapositive photos for mapping provided us with the highest resolution possible. The diapositive photos are also dimensionally stable and virtually not affected by temperature and humidity changes. The paper contact prints are less desirable because they are grainier, and the paper base can expand and contract slightly with changes in temperature and humidity.

We registered mapping overlays to the CIR aerial photos (1:12,000-scale) from October 2007 by using the fiducials (standard reference points) and identification information of the photo. We viewed the CIR aerial photos for interpretation by using Richards MIM light tables and Bausch & Lomb Zoom 240 stereoscopes with variable zoom capabilities. Features within the entire project extent were mapped to a minimum mapping unit (MMU) of 0.5 ha between map classes and a MMU of 2.0 ha between physiognomic modifiers within a map-class unit. Exceptions for mapping below the MMU (down to 0.25 ha) were allowed for instances when vegetation unique to the immediate surroundings (e.g., herbaceous wetland within an upland forest).[2] Interpreted data, such as map polygons and attributes, were applied to photo overlays covering the CIR photos. True-color aerial photos (1:12,000-scale) from April 2007 were viewed digitally on

[2] It should also be noted that we allowed polygons as low as 0.1 ha once clipped by the project boundary.

computer and/or by using a Topcon (MS-3) mirror stereoscope with 3x binoculars to aid interpretation of the CIR photos.

Each diapositive photo was paired with the adjacent photo (stereo pair) so we could view the images three-dimensionally. We delineated features and scribed their corresponding map-attribute codes onto the acetate overlays by using Rapidograph ink pens (4x0-size, 0.18 mm) and Rapidraw black India ink (3084; waterproof, fast drying for film). We applied standard photo signature characteristics, including texture, color, pattern, and position in the landscape to guide placement of polygons. In addition to photo signature characteristics, understanding the environmental distribution of the vegetation types helped us not only to identify types, but also to properly place polygon boundaries. For each polygon, the appropriate map-class code and physiognomic modifier codes (collectively, the map-attribute code) were applied to each map polygon unit. For quality assurance, a second photointerpreter reviewed the interpreted work.

Digital Map Automation and Database Development

We converted the photointerpreted data into a format usable in a geographic information system (GIS) by employing three fundamental processes, as follows: (1) orthorectify, (2) digitize, and (3) develop the geodatabase. All digital map automation was projected in Universal Transverse Mercator (UTM), Zone 16, by using the North American Datum of 1983 (NAD83).

Orthorectify: We orthorectified the interpreted overlays by using OrthoMapper, a softcopy photogrammetric software for GIS. One function of OrthoMapper is to create orthorectified imagery from scanned and nonrectified imagery (Image Processing Software, Inc., 2002). The software features a method of visual orientation involving a point-and-click operation that uses existing orthorectified horizontal and vertical base maps. Of primary importance to us, OrthoMapper also has the capability to orthorectify the photointerpreted overlays of each photograph according to the reference information provided.

Digitize: To produce a polygon vector layer for use in GIS, we converted each raster-based image mosaic of orthorectified overlays containing the photointerpreted data into a grid format by using ArcGIS (Environmental Systems Research Institute [ESRI], Redlands, California). In ArcGIS, we used the ArcScan extension to trace the raster data and produce ESRI shapefiles. We digitally assigned map-attribute codes (both map-class and physiognomic modifier codes) to the polygons and checked the digital data against the photointerpreted overlays for line and attribute consistency. Ultimately, we merged the individual layers into a seamless layer.

Geodatabase: At this stage, the map layer would have only map-attribute codes assigned to each polygon. To assign meaningful information to each polygon (e.g., map-class names, physiognomic definitions, links to NVCS types), we produced a feature-class table, along with other supportive tables, and subsequently related them together via an ArcGIS Geodatabase. This geodatabase also links the map to other feature-class layers produced from this project, including vegetation sample plots, accuracy assessment (AA) sites, aerial photo locations, and project boundary extent. A geodatabase provides access to a variety of interlocking data sets, is expandable, and equips resource managers and researchers with a powerful GIS tool.

Results

Map Classes

We developed 75 map classes (including map-class phases) to map the SLBE and environs. Of these 75 map classes, 67 represent natural/semi-natural vegetation types within the NVCS, four represent cultural vegetation types (agriculture and developed) within the NVCS, and four represent non-vegetation features (open water, barren land). Table 10 provides a breakdown of these map classes in regards to the finer levels of the NVCS, including the floristic (association or alliance), group, and macrogroup. The units not included in the NVCS are listed as well. Explanations of the distribution of map classes within each Class level in the NVCS are provided in the section after the table. An approach to understanding the figures in this table is provided in the following example:

> Of the 71 map classes representing types in the NVCS, 34 represent types within the Forest & Woodland Class. As explained in the section after the table, five of these 34 map classes are map-class phases of two associations. Not every vegetation type that a map class represents is necessarily identified to the floristic levels (association and alliance) of the NVCS, but some might be identified to the broader level of group. Of the 34 map classes that represent association or alliance types (which is 29 map classes), 26 floristic types (association or alliance) are represented by the 29 map classes. The five remaining map classes represent vegetation types above the floristic levels, and as the section after the table explains, they fall into two group types. Furthermore, the 34 map classes represent a total of 12 group types and 8 macrogroup types of the NVCS.

Table 10. Map-class distribution within the National Vegetation Classification Standard for the Sleeping Bear Dunes National Lakeshore (Michigan) vegetation mapping project.

[NVCS, National Vegetation Classification Standard; NLCD, National Land Cover Database; n/a, not applicable]

NVCS Classes	Map Class*	Floristic**	Group	Macrogroup
FOREST & WOODLAND	34	26	12	8
SHRUBLAND & GRASSLAND	31	23	10	8
AQUATIC VEGETATION	2	2	1	1
AGRICULTURAL VEGETATION CULTURAL	3	n/a	n/a	n/a
DEVELOPED VEGETATION CULTURAL	1	n/a	n/a	n/a
NVCS TOTAL	**71**	**51**	**23**	**17**

Non-NVCS Units (NLCD 2001)	Map Class
Open Water	3
Barren Land	1
Non-NVCS Total	**4**
Map Class Grand Total	**75**

* The map-class value is the sum of map classes and their combined phases. For example, one map class with two phases is counted as two map classes.

** Within the hierarchical levels of the NVCS, “floristic” refers to association and alliance types collectively; however, here in this table and in regards to the number tally, floristic refers to either an association or an alliance type, but not both. There was one map class representing a vegetation type within the floristic category that was classified to the alliance level, whereas all others were classified to the association level.

Map Classes in the NVCS

Sixty-seven map classes represent natural/semi-natural types in the NVCS and four represent cultural types (agriculture and developed, of which developed is modified into further detail by using the NLCD 2001 units) in the NVCS. Ten map classes rest at the group level in the NVCS. Fifty-seven map classes represent 51 floristic (association or alliance) types in the NVCS, of which 11 are phases of five association types. One of the 51 floristic types is an alliance, and the remaining 50 are associations. The following is a breakdown of map classes and their relation to the NVCS, organized by NVCS class:

Forest & Woodland: Thirty-four map classes represent 28 natural/semi-natural vegetation types. Five map classes rest at two group types, with four of the map classes belonging to a ruderal forest group and one belonging to a plantation group. Twenty-nine map classes represent 26 floristic types (all at the association level); five of these map classes are phases of two of the associations.

Shrubland & Grassland: Thirty-one map classes represent 24 natural/semi-natural vegetation types[3]. Three map classes rest at two group types, with two of the map classes belonging to a ruderal shrubland group and one map class belonging to a wet meadow herbaceous group (of which other associations fall under). Twenty-six map classes represent 23 floristic types, with one of the map classes representing an alliance-level type and the other 25 map classes representing 22 association-level types; six of these map classes are phases of three of the associations.

Aquatic Vegetation: Two map classes represent two natural/semi-natural vegetation types, with both representing association-level types.

Agricultural Vegetation Cultural: Three map classes represent three cultural vegetation types at various levels in the cultural portion of the NVCS.

Developed Vegetation Cultural: One map class—developed areas—represents one cultural vegetation type at the formation level in the cultural portion of the NVCS. This map class is modified into further detail by using NLCD 2001 classification units.

Map Classes Not in the NVCS

Four map classes represent non-vegetation features not described in the NVCS, which correlate to the NLCD 2001 classification. We have categorized these map classes into the two following groups: Non-vegetated Water and Non-vegetated Land.

Map Classification Link to Types in the NVCS

Table 11 lists the map classes (map-class phases included) as they relate to the NVCS. It is organized first by class, then by division, macrogroup, group, and, finally, floristic type (mostly at the association level). Map classes rest in the finest possible level of the NVCS.

[3] One of these 31 map classes, the Wet Meadow Mixed Herbaceous, represents vegetation of ruderal wet meadows, which could only be classified within the Eastern North American Freshwater Group (G112); however, G112 is already represented by several map classes that are linked to various association and alliance-level types that fall within the G112.

Table 11. Map classification with crosswalk to the National Vegetation Classification Standard, Version 2 (FGDC 2008) for the Sleeping Bear Dunes National Lakeshore (Michigan) vegetation mapping project.

[NVCS, National Vegetation Classification Standard; NLCD, National Land Cover Database]

Map-class Code	Map-class Name
1. FOREST & WOODLAND CLASS	
1.C.2.Na. (D008.) Eastern North American Cool Temperate Forest Division	
M153. Central Mesophytic Hardwood Forest Macrogroup	
G021. North-Central Beech - Maple - Basswood - Oak Forest Group	
Acer saccharum - *Fagus grandifolia* - *Betula* spp. / *Maianthemum canadense* Forest Association (CEGL005004)	
FBM	Beech - Maple - Northern Hardwoods Forest
M013. Eastern North American Ruderal Forest & Plantation Macrogroup	
G032. Northern & Central Conifer & Hardwood Plantation Group	
FPE	Conifer Plantation
G030. Northern & Central Hardwood & Conifer Ruderal Forest Group	
FCX	Conifer Ruderal Forest
FDX	Hardwood Ruderal Forest (hardwood mix phase)
FBX	Hardwood Ruderal Forest (black locust phase)
FMX	Conifer - Hardwood Ruderal Forest
M159. Northern & Eastern Pine - Oak Forest, Woodland & Barrens Macrogroup	
G160. Great Lakes Pine Barrens Group	
Pinus banksiana - *Pinus resinosa* - *Pinus strobus* Dune Forest Association (CEGL002589)	
FPD	Great Lakes Dune Pine Forest
G025. White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group	
Pinus banksiana - (*Pinus resinosa*) - *Quercus ellipsoidalis* / *Carex pensylvanica* Forest Association (CEGL002478)	
FJO	Jack Pine - Northern Pin Oak Forest
Pinus resinosa - *Populus tremuloides* / *Diervilla lonicera* - *Vaccinium* spp. Forest Association (CEGL002520)	
FRA	Red Pine - Aspen - Birch Forest
Pinus resinosa / *Vaccinium* spp. Forest Association (CEGL002443)	
FRP	Red Pine / Blueberry Dry Forest
Pinus strobus - (*Pinus resinosa*) - *Quercus rubra* Forest Association (CEGL002480)	
FWO	White Pine - Red Oak Forest
Pinus strobus - *Populus tremuloides* / *Corylus cornuta* Forest Association (CEGL002479)	
FWA	White Pine - Aspen - Birch Forest
Pinus strobus / *Vaccinium* spp. Forest Association (CEGL002444)	
FWP	White Pine / Blueberry Dry-Mesic Forest

Map-class Code	Map-class Name
	M014. Northern Mesic Hardwood & Conifer Forest Macrogroup
	G163. Northern Hardwood - Hemlock - White Pine Forest Group
	Acer saccharum - *Fraxinus americana* - *Tilia americana* / *Acer spicatum* / *Caulophyllum thalictroides* Forest Association (CEGL005008)
FMA	Sugar Maple - Ash - Basswood Northern Rich Mesic Forest
	Populus tremuloides - *Betula papyrifera* - (*Acer rubrum*, *Populus grandidentata*) Forest Association (CEGL002467)
FBR	Aspen - Birch - Red Maple Forest
	Quercus rubra - *Acer saccharum* - (*Betula alleghaniensis*) Forest Association (CEGL002461)
FOM	Northern Red Oak - Sugar Maple Forest
	Thuja occidentalis / *Abies balsamea* - *Acer spicatum* Forest Association (CEGL002449)
FCC	White-cedar - Boreal Conifer Mesic Forest (conifer phase)
FCB	White-cedar - Boreal Conifer Mesic Forest (yellow birch interior phase)
FCM	White-cedar - Boreal Conifer Mesic Forest (maple coastal dune phase)
	Tsuga canadensis - (*Betula alleghaniensis*) Forest Association (CEGL002598)
FHC	Hemlock Mesic Forest
	Tsuga canadensis - *Fagus grandifolia* - (*Acer saccharum*) Great Lakes Forest Association (CEGL005042)
FHB	Great Lakes Hemlock - Beech - Hardwood Forest
	1.C.3.Na. (D011.) Eastern North American Flooded & Swamp Forest Division
	M030. Northern & Central Swamp Forest Macrogroup
	G046. Northern & Central Conifer & Hardwood Alkaline Swamp Group
	Acer rubrum - *Fraxinus* spp. - *Betula papyrifera* / *Cornus canadensis* Forest Association (CEGL002071)
FRM	Red Maple - Ash - Birch Swamp Forest
	Fraxinus nigra - Mixed Hardwoods - Conifers / *Cornus sericea* / *Carex* spp. Forest Association (CEGL002105)
FBA	Black Ash - Mixed Hardwood Swamp
	Larix laricina / *Photinia melanocarpa* / *Sphagnum* spp. Forest Association (CEGL002472)
FTS	Central Tamarack Poor Swamp
	Pinus strobus - (*Acer rubrum*) / *Osmunda* spp. Forest Association (CEGL002482)
FWS	White Pine - Red Maple Swamp
	Thuja occidentalis - *Fraxinus nigra* Forest Association (CEGL005165)
FCA	White-cedar - Black Ash Swamp
	Tsuga canadensis - *Betula alleghaniensis* Saturated Forest Association (CEGL005003)
FHS	Hemlock - Yellow Birch Swamp Wet-Mesic Forest
	M160. Northern & Central Tall Shrub Wetland Macrogroup
	G167. Northern & Central Shrub Swamp Group
	Alnus incana Swamp Shrubland Association (CEGL002381)
SAS	Gray Alder Swamp

Map-class Code	Map-class Name
1.D.1.Na. (D014.) North American Boreal Forest Division	
M037. Eastern & Central North American Boreal Conifer & Hardwood Forest Macrogroup	
G047. Jack Pine - Black Spruce Forest Group	
Pinus banksiana / *Vaccinium* spp. / *Pleurozium schreberi* Forest Association (CEGL002441)	
FJB	Jack Pine / Blueberry / Feathermoss Forest
G048. White Spruce - Balsam Fir Forest Group	
Picea glauca - *Abies balsamea* - *Populus tremuloides* / Mixed Herbs Forest Association (CEGL002475)	
FCP	Spruce - Fir - Aspen Forest
1.D.2.Na. (D016.) North American Boreal Flooded & Swamp Forest Division	
M299. North American Boreal Swamp Forest Macrogroup	
G050. Eastern Black Spruce - Tamarack Acidic Swamp Group	
Picea mariana - (*Larix laricina*) / *Ledum groenlandicum* / *Sphagnum* spp. Forest Association (CEGL005271)	
FSS	Black Spruce - Tamarack / Labrador-tea Poor Swamp (black spruce phase)
FTP	Black Spruce - Tamarack / Labrador-tea Poor Swamp (tamarack phase)
G051. Eastern Tamarack - Conifer Alkaline Swamp Group	
Larix laricina / *Alnus incana* Forest Association (CEGL002471)	
FTR	Northern Tamarack Rich Swamp
Thuja occidentalis - (*Picea mariana*, *Abies balsamea*) / *Alnus incana* Forest Association (CEGL002456)	
FCS	White-cedar - (Mixed Conifer) / Alder Swamp
2. SHRUBLAND & GRASSLAND CLASS	
2.C.1.Nc. (D024.) Eastern North American Grassland, Meadow & Shrubland Division	
M163. Eastern North American Prairie & Barrens Macrogroup	
G063. Northern & Central Sand Barrens Group	
Pteridium aquilinum - *Bromus kalmii* Herbaceous Vegetation Association (CEGL005142)	
HBF	Bracken Grassland
M123. Eastern North American Ruderal Shrubland & Grassland Macrogroup	
G059. Northern & Central Ruderal Meadow & Shrubland Group	
SCX	Conifer Ruderal Shrubland
SDX	Deciduous Ruderal Shrubland
SMX	Conifer - Deciduous Ruderal Shrubland
HMX	Ruderal Grassland
2.C.3.Na. (D026.) Eastern North American Dune & Coastal Grassland & Shrubland Division	
M176. Eastern North American Beach, Shoreline & Flat Macrogroup	
G342. Eastern North American Lake Flat & Beach Group	
Inland Freshwater Strand Beach Sparse Vegetation Association (CEGL002310)	
VAV	Inland Freshwater Strand Beach

Map-class Code	Map-class Name
	M057. Eastern North American Coastal Grassland & Shrubland Macrogroup
	G089. Great Lakes Dune Grassland & Shrubland Group
	Ammophila breviligulata - (*Schizachyrium scoparium*) Herbaceous Vegetation (CEGL005098)
HAB	Great Lakes Beachgrass Dune
	Cakile edentula Great Lakes Shore Sparse Vegetation Association (CEGL005162)
VBO	Great Lakes Beach (blowout phase)
VES	Great Lakes Beach (erodable sand bank phase)
	Dasiphora fruticosa ssp. *floribunda* / *Cladium mariscoides* - *Juncus balticus* - (*Rhynchospora capillacea*) Herbaceous Vegetation Association (CEGL005105)
HDW	Interdunal Wetland
	Juniperus horizontalis - *Arctostaphylos uva-ursi* - *Juniperus communis* Dune Dwarf-shrubland Association (CEGL005064)
DJD	Great Lakes Juniper Dune Shrubland
	Pinus banksiana - (*Pinus resinosa*) - *Pinus strobus* / *Juniperus horizontalis* Wooded Herbaceous Vegetation Association (CEGL005125)
HPB	Great Lakes Coast Pine Barrens (barrens phase)
HPW	Great Lakes Coast Pine Barrens (woodland phase)
	Populus deltoides Woodland Alliance (A.1493)
WPB	Eastern Cottonwood Woodland (paper birch variant)
	Populus deltoides - (*Juniperus virginiana*) Dune Woodland Association (CEGL005119)
WCD	Cottonwood Dune Open Woodland
	Prunus pumila - (*Ptelea trifoliata*) Dune Shrubland Association (CEGL005075)
SCW	Sand Cherry Dune Shrubland
	2.C.4.Na. (D029.) North American Bog & Fen Division
	M062. North American Boreal Bog & Fen Macrogroup
	G386. Eastern North American Boreal Acidic Bog & Poor Fen Group
	Chamaedaphne calyculata / *Carex oligosperma* / *Sphagnum* spp. Poor Fen Dwarf-shrubland Association (CEGL005277)
DLF	Leatherleaf Poor Fen
	G185. Eastern North American Boreal Alkaline Fen Group
	Calamagrostis canadensis - *Carex viridula* - *Cladium mariscoides* - *Lobelia kalmii* Herbaceous Vegetation Association (CEGL005115)
HSM	Great Lakes Sedge Rich Shore Fen
	Carex lasiocarpa - (*Carex rostrata*) - *Equisetum fluviatile* Herbaceous Vegetation Association (CEGL005229)
HSS	Woolly-fruit Sedge Shore Fen
	Chamaedaphne calyculata - *Myrica gale* / *Carex lasiocarpa* Dwarf-shrubland Association (CEGL005228)
DLS	Leatherleaf - Sweetgale Shore Fen
	Dasiphora fruticosa ssp. *floribunda* - *Myrica gale* Rich Shore Fen Shrubland Association (CEGL005275)
SSF	Shrubby-cinquefoil - Sweetgale Rich Shore Fen

Map-class Code	Map-class Name
	2.C.5.Na. (D030.) Eastern North American Freshwater Wet Meadow, Riparian & Marsh Division
	M067. Atlantic & Gulf Coastal Plain Pondshore & Wet Meadow Macrogroup
	G111. Atlantic & Gulf Coastal Plain Pondshore & Wet Prairie Group
	Rhynchospora capitellata - *Rhexia virginica* - *Rhynchospora scirpoides* - *Schoenoplectus hallii* Herbaceous Vegetation Association (CEGL005108)
HCP	Inland Coastal Plain Marsh
	M303. Eastern North American Ruderal Wet Meadow & Marsh Macrogroup
	G556. Northern & Central Ruderal Wet Meadow & Marsh Group
	Phragmites australis Eastern North America Temperate Semi-natural Herbaceous Vegetation Association (CEGL004141)
HPG	Eastern Reed Marsh
	M069. Eastern North American Wet Meadow & Marsh Macrogroup
	G125. Eastern North American Freshwater Marsh Group
	Schoenoplectus acutus - *Schoenoplectus subterminalis* - *Eleocharis palustris* - (*Schoenoplectus americanus*) Northern Great Lakes Shore Herbaceous Vegetation Association (CEGL005274)
HEM	Northern Great Lakes Emergent Marsh
	Typha spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation Association (CEGL002229)
HCM	Midwest Mixed Emergent Deep Marsh
	G112. Eastern North American Wet Meadow Group
HWM	Wet Meadow Mixed Herbaceous
	Calamagrostis canadensis - *Eupatorium maculatum* Herbaceous Vegetation Association (CEGL005174)
HCC	Bluejoint Wet Meadow
	Carex (*rostrata*, *utriculata*) - *Carex lacustris* - (*Carex vesicaria*) Herbaceous Vegetation Association (CEGL002257)
HSG	Northern Sedge Wet Meadow
	Carex stricta - *Carex* spp. Herbaceous Vegetation Association (CEGL002258)
HUS	Upright Sedge Wet Meadow
	Cornus sericea - *Salix* spp. - (*Rosa palustris*) Shrubland Association (CEGL002186)
SDW	Dogwood - Willow Swamp (dogwood - willow phase)
SBC	Dogwood - Willow Swamp (black chokecherry phase)
5. AQUATIC VEGETATION CLASS	
	5.B.1.Na. (D049.) North American Freshwater Aquatic Vegetation Division
	M108. Eastern North American Freshwater Aquatic Vegetation Macrogroup
	G114. Eastern North American Freshwater Aquatic Vegetation Group
	Nymphaea odorata - *Nuphar* (*microphylla*, *variegata*) Herbaceous Vegetation Association (CEGL002562)
HFA	Northern Water-lily Aquatic Wetland
	Potamogeton spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation Association (CEGL002282)
HSV	Midwest Pondweed Submerged Aquatic Wetland

Map-class Code	Map-class Name
7. AGRICULTURAL VEGETATION CULTURAL CLASS	
Woody Agricultural Vegetation Subclass (L2)	
Woody Horticultural Crop Formation (L3)	
Orchard (tree) Subformation (L4)	
Fruit - Orchards Subgroup (L6)	
FOD	Deciduous Orchard
Herbaceous Agricultural Vegetation Subclass (L2)	
Cultivated Crop Formation (L3)	
HCF	Crop Field
Pasture / Hay Formation (L3)	
Permanent Pasture & Hayland Subformation (L4)	
HPF	Pasture Field
8. DEVELOPED VEGETATION CULTURAL CLASS	
Herbaceous & Woody Developed Vegetation Cultural Subclass (L2)	
Other Developed Urban / Built Up Vegetation Formation (L3)	
Developed Area (NLCD 2001; 21-24)	
CDV	Developed Area
NON-NVCS UNITS	
Non-Vegetated Water & Land (<1% vegetated)	
Non-Vegetated Water	
Open Water (NLCD 2001; 11)	
NSR	Stream & River
NWP	Open Water Pond
NWL	Open Water Lake
Non-Vegetated Land	
Barren Land (NLCD 2001; 31)	
NSB	Sand & Cobble Beach

Map Classification Descriptions

We provide descriptions of map classes (and their phases) representing those vegetation types in the NVCS, as well as of non-vegetation features. These descriptions are provided in Appendix E: Descriptions of Map Classes. These descriptions point out the link between map classes and the types/units they represent. In addition, a succinct explanation is given of how map classes were employed during the AA analysis. Representative ground photos are provided as well.

Summary Report of the Map Layer

Table 12 provides a summary report of the spatial-data layer (map) of SLBE and summarizes frequency, area, and average polygon size for each map class (including phases). Table 13 provides a summary report with map classes compiled at the group level within the NVCS. These summary reports organize the map classes by hierarchy within the NVCS and represent all lands within the established project boundary extent, including the environs.

Following the tables are some general observations and inferences we made from a quick study of the summary reports. Although many more inferences can be made, these are provided as an example of how one might begin to analyze the map layer and garner information from it.

Table 12. Frequencies and areas of map classes (organized via the National Vegetation Classification Standard, Version 2 [FGDC 2008]) represented in the vegetation map layer for the Sleeping Bear Dunes National Lakeshore (Michigan) vegetation mapping project.

[Freq, Frequency; Ha, Hectare; Ave, Average; Ac, Acre; NVCS, National Vegetation Classification Standard]

Map Code	Map-class Name	Freq	Area (Ha)	Ave (Ha)	Area (Ac)	Ave (Ac)
FOREST & WOODLAND CLASS						
North-Central Beech - Maple - Basswood - Oak Forest Group						
FBM	Beech - Maple - Northern Hardwoods Forest	902	10,507.9	11.6	25,965.5	28.8
Northern & Central Conifer & Hardwood Plantation Group						
FPE	Conifer Plantation	331	526.8	1.6	1,301.7	3.9
Northern & Central Hardwood & Conifer Ruderal Forest Group						
FCX	Conifer Ruderal Forest	144	137.1	1.0	338.7	2.4
FDX	Hardwood Ruderal Forest (hardwood mix phase)	580	858.5	1.5	2,121.5	3.7
FBX	Hardwood Ruderal Forest (black locust phase)	78	87.3	1.1	215.8	2.8
FMX	Conifer - Hardwood Ruderal Forest	331	363.8	1.1	899.0	2.7
Great Lakes Pine Barrens Group						
FPD	Great Lakes Dune Pine Forest	77	120.1	1.6	296.8	3.9
White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group						
FJO	Jack Pine - Northern Pin Oak Forest	22	38.0	1.7	93.8	4.3
FRA	Red Pine - Aspen - Birch Forest	48	98.4	2.1	243.3	5.1
FRP	Red Pine / Blueberry Dry Forest	46	72.1	1.6	178.2	3.9
FWO	White Pine - Red Oak Forest	369	1,570.9	4.3	3,881.8	10.5
FWA	White Pine - Aspen - Birch Forest	281	613.3	2.2	1,515.4	5.4
FWP	White Pine / Blueberry Dry-Mesic Forest	36	60.7	1.7	149.9	4.2
Northern Hardwood - Hemlock - White Pine Forest Group						
FMA	Sugar Maple - Ash - Basswood Northern Rich Mesic Forest	139	177.0	1.3	437.3	3.1
FBR	Aspen - Birch - Red Maple Forest	673	1,468.2	2.2	3,627.9	5.4
FOM	Northern Red Oak - Sugar Maple Forest	769	2,882.5	3.7	7,122.8	9.3
FCC	White-cedar - Boreal Conifer Mesic Forest (conifer phase)	87	133.4	1.5	329.5	3.8
FCB	White-cedar - Boreal Conifer Mesic Forest (yellow birch interior phase)	201	333.0	1.7	823.0	4.1
FCM	White-cedar - Boreal Conifer Mesic Forest (maple coastal dune phase)	137	131.5	1.0	324.9	2.4
FHC	Hemlock Mesic Forest	31	30.8	1.0	76.1	2.5
FHB	Great Lakes Hemlock - Beech - Hardwood Forest	400	642.0	1.6	1,586.4	4.0

Map Code	Map-class Name	Freq	Area (Ha)	Ave (Ha)	Area (Ac)	Ave (Ac)
Northern & Central Conifer & Hardwood Alkaline Swamp Group						
FRM	Red Maple - Ash - Birch Swamp Forest	149	154.3	1.0	381.2	2.6
FBA	Black Ash - Mixed Hardwood Swamp	115	131.8	1.1	325.7	2.8
FTS	Central Tamarack Poor Swamp	2	3.3	1.6	8.1	4.1
FWS	White Pine - Red Maple Swamp	22	21.1	1.0	52.3	2.4
FCA	White-cedar - Black Ash Swamp	146	217.3	1.5	536.9	3.7
FHS	Hemlock - Yellow Birch Swamp Wet-Mesic Forest	12	13.6	1.1	33.5	2.8
Northern & Central Shrub Swamp Group						
SAS	Gray Alder Swamp	66	51.1	0.8	126.3	1.9
Jack Pine - Black Spruce Forest Group						
FJB	Jack Pine / Blueberry / Feathermoss Forest	45	82.0	1.8	202.5	4.5
White Spruce - Balsam Fir Forest Group						
FCP	Spruce - Fir - Aspen Forest	4	9.8	2.5	24.3	6.1
Eastern Black Spruce - Tamarack Acidic Swamp Group						
FSS	Black Spruce - Tamarack / Labrador-tea Poor Swamp (black spruce phase)	3	2.4	0.8	6.0	2.0
FTP	Black Spruce - Tamarack / Labrador-tea Poor Swamp (tamarack phase)	9	19.0	2.1	47.0	5.2
Eastern Tamarack - Conifer Alkaline Swamp Group						
FTR	Northern Tamarack Rich Swamp	12	18.4	1.5	45.6	3.8
FCS	White-cedar - (Mixed Conifer) / Alder Swamp	58	164.3	2.8	405.9	7.0
SHRUBLAND & GRASSLAND CLASS						
Northern & Central Sand Barrens Group						
HBF	Bracken Grassland	11	7.7	0.7	19.0	1.7
Northern & Central Ruderal Meadow & Shrubland Group						
SCX	Conifer Ruderal Shrubland	56	133.0	2.4	328.5	5.9
SDX	Deciduous Ruderal Shrubland	58	53.6	0.9	132.5	2.3
SMX	Conifer - Deciduous Ruderal Shrubland	57	89.5	1.6	221.2	3.9
HMX	Ruderal Grassland	669	1,646.0	2.5	4,067.4	6.1
Eastern North American Lake Flat & Beach Group						
VAV	Inland Freshwater Strand Beach	12	12.4	1.0	30.6	2.5

Map Code	Map-class Name	Freq	Area (Ha)	Ave (Ha)	Area (Ac)	Ave (Ac)
Great Lakes Dune Grassland & Shrubland Group						
HAB	Great Lakes Beachgrass Dune	240	1,542.4	6.4	3,811.5	15.9
VBO	Great Lakes Beach (blowout phase)	34	48.7	1.4	120.3	3.5
VES	Great Lakes Beach (erodable sand bank phase)	17	123.8	7.3	305.9	18.0
HDW	Interdunal Wetland	5	2.1	0.4	5.1	1.0
DJD	Great Lakes Juniper Dune Shrubland	296	460.6	1.6	1,138.2	3.8
HPB	Great Lakes Coast Pine Barrens (barrens phase)	99	68.4	0.7	168.9	1.7
HPW	Great Lakes Coast Pine Barrens (woodland phase)	90	150.0	1.7	370.7	4.1
WPB	Eastern Cottonwood Woodland (paper birch variant)	91	42.2	0.5	104.3	1.1
WCD	Cottonwood Dune Open Woodland	57	27.6	0.5	68.3	1.2
SCW	Sand Cherry Dune Shrubland	41	24.4	0.6	60.2	1.5
Eastern North American Boreal Acidic Bog & Poor Fen Group						
DLF	Leatherleaf Poor Fen	28	78.2	2.8	193.2	6.9
Eastern North American Boreal Alkaline Fen Group						
HSM	Great Lakes Sedge Rich Shore Fen	40	30.9	0.8	76.4	1.9
HSS	Woolly-fruit Sedge Shore Fen	2	7.2	3.6	17.7	8.9
DLS	Leatherleaf - Sweetgale Shore Fen	5	4.0	0.8	9.9	2.0
SSF	Shrubby-cinquefoil - Sweetgale Rich Shore Fen	17	10.0	0.6	24.8	1.5
Atlantic & Gulf Coastal Plain Pondshore & Wet Prairie Group						
HCP	Inland Coastal Plain Marsh	2	2.1	1.1	5.2	2.6
Northern & Central Ruderal Wet Meadow & Marsh Group						
HPG	Eastern Reed Marsh	8	3.5	0.4	8.7	1.1
Eastern North American Freshwater Marsh Group						
HEM	Northern Great Lakes Emergent Marsh	44	38.1	0.9	94.0	2.1
HCM	Midwest Mixed Emergent Deep Marsh	65	46.9	0.7	115.9	1.8
Eastern North American Wet Meadow Group						
HWM	Wet Meadow Mixed Herbaceous	50	32.0	0.6	79.1	1.6
HCC	Bluejoint Wet Meadow	147	75.0	0.5	185.3	1.3
HSG	Northern Sedge Wet Meadow	60	32.9	0.5	81.4	1.4
HUS	Upright Sedge Wet Meadow	2	1.6	0.8	4.0	2.0
SDW	Dogwood - Willow Swamp (dogwood - willow phase)	222	195.0	0.9	481.8	2.2
SBC	Dogwood - Willow Swamp (black chokecherry phase)	11	12.0	1.1	29.7	2.7

Map Code	Map-class Name	Freq	Area (Ha)	Ave (Ha)	Area (Ac)	Ave (Ac)
AQUATIC VEGETATION CLASS						
Eastern North American Freshwater Aquatic Vegetation Group						
HFA	Northern Water-lily Aquatic Wetland	8	14.3	1.8	35.4	4.4
HSV	Midwest Pondweed Submerged Aquatic Wetland	17	17.5	1.0	43.2	2.5
AGRICULTURAL VEGETATION CULTURAL CLASS						
Fruit - Orchards Subgroup						
FOD	Deciduous Orchard	41	115.6	2.8	285.6	7.0
Cultivated Crop Formation						
HCF	Crop Field	24	130.7	5.4	323.1	13.5
Permanent Pasture & Hayland Subformation						
HPF	Pasture Field	35	112.1	3.2	277.1	7.9
DEVELOPED VEGETATION CULTURAL CLASS						
Developed Area						
CDV	Developed Area	225	1,107.4	4.9	2,736.5	12.2
NON-NVCS UNITS						
Open Water						
NSR	Stream & River	13	34.8	2.7	86.0	6.6
NWP	Open Water Pond	18	22.5	1.2	55.5	3.1
NWL	Open Water Lake	30	5,275.7	175.9	13,036.6	434.6
Barren Land						
NSB	Sand & Cobble Beach	24	166.6	6.9	411.7	17.2

Table 13. Frequencies and areas of map classes (compiled at the group level in the National Vegetation Classification Standard) represented in the vegetation map layer for the Sleeping Bear Dunes National Lakeshore (Michigan) vegetation mapping project.

[Freq, Frequency; Ha, Hectare; Ave, Average; Ac, Acre; NVCS, National Vegetation Classification Standard]

NVCS Class and Group Name	Freq	Area (Ha)	Ave (Ha)	Area (Ac)	Ave (Ac)
FOREST & WOODLAND CLASS	**6,325**	**21,741.6**	**3.4**	**53,724.6**	**8.5**
North-Central Beech - Maple - Basswood - Oak Forest Group	902	10,507.9	11.6	25,965.5	28.8
Northern & Central Conifer & Hardwood Plantation Group	331	526.8	1.6	1,301.7	3.9
Northern & Central Hardwood & Conifer Ruderal Forest Group	1,133	1,446.7	1.3	3,574.9	3.2
Great Lakes Pine Barrens Group	77	120.1	1.6	296.8	3.9
White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group	802	2,453.4	3.1	6,062.4	7.6
Northern Hardwood - Hemlock - White Pine Forest Group	2,437	5,798.3	2.4	14,327.9	5.9
Northern & Central Conifer & Hardwood Alkaline Swamp Group	446	541.4	1.2	1,337.7	3.0
Northern & Central Shrub Swamp Group	66	51.1	0.8	126.3	1.9
Jack Pine - Black Spruce Forest Group	45	82.0	1.8	202.5	4.5
White Spruce - Balsam Fir Forest Group	4	9.8	2.5	24.3	6.1
Eastern Black Spruce - Tamarack Acidic Swamp Group	12	21.5	1.8	53.0	4.4
Eastern Tamarack - Conifer Alkaline Swamp Group	70	182.7	2.6	451.5	6.4
SHRUBLAND & GRASSLAND CLASS	**2,536**	**5,001.8**	**2.0**	**12,359.8**	**4.9**
Northern & Central Sand Barrens Group	11	7.7	0.7	19.0	1.7
Northern & Central Ruderal Meadow & Shrubland Group	840	1,921.1	2.3	4,749.7	5.7
Eastern North American Lake Flat & Beach Group	12	12.4	1.0	30.6	2.5
Great Lakes Dune Grassland & Shrubland Group	970	2,490.2	2.6	6,153.3	6.3
Eastern North American Boreal Acidic Bog & Poor Fen Group	28	78.2	2.8	193.2	6.9
Eastern North American Boreal Alkaline Fen Group	64	52.1	0.8	138.8	2.0
Atlantic & Gulf Coastal Plain Pondshore & Wet Prairie Group	2	2.1	1.1	5.2	2.6
Northern & Central Ruderal Wet Meadow & Marsh Group	8	3.5	0.4	8.7	1.1
Eastern North American Freshwater Marsh Group	109	85.0	0.8	209.9	1.9
Eastern North American Wet Meadow Group	492	348.5	0.7	861.2	1.8
AQUATIC VEGETATION CLASS	**25**	**31.8**	**1.3**	**78.7**	**3.1**
Eastern North American Freshwater Aquatic Vegetation Group	25	31.8	1.3	78.7	3.1
NVCS Subtotal	**8,886**	**26,775.2**	**3.0**	**66,163.0**	**7.4**

NVCS Class and Group Name	Freq	Area (Ha)	Ave (Ha)	Area (Ac)	Ave (Ac)
AGRICULTURAL VEGETATION CULTURAL CLASS	**100**	**358.3**	**3.6**	**885.7**	**8.9**
Fruit - Orchards Subgroup	41	115.6	2.8	285.6	7.0
Cultivated Crop Formation	24	130.7	5.4	323.1	13.5
Permanent Pasture & Hayland Subformation	35	112.1	3.2	277.1	7.9
DEVELOPED VEGETATION CULTURAL CLASS	**225**	**1,107.4**	**4.9**	**2,736.5**	**12.2**
Developed Area	225	1,107.4	4.9	2,736.5	12.2
NVCS Cultural Subtotal	**325**	**1,465.9**	**4.5**	**3,622.2**	**11.1**
NON-NVCS UNITS	**85**	**5,499.6**	**64.7**	**13,589.9**	**159.9**
Open Water	61	5,333.0	87.4	13,178.1	216.0
Barren Land	24	166.6	6.9	411.7	17.2
Non-NVCS Subtotal	**85**	**5,499.6**	**64.7**	**13,589.9**	**159.9**
Grand Total	**9,296**	**33,740.7**	**3.6**	**83,375.1**	**9.0**

Brief Analysis and Discussion

Collectively, the SLBE spatial database layer is composed of 9,296 polygons covering 33,740.7 ha, with an average polygon size of 3.6 ha. Map classes representing natural/semi-natural types in the NVCS apply to 8,886 polygons (95.6% of all polygons, with an average polygon size of 3.0 ha) and cover 26,775.2 ha (79.4% of the entire area).

The Forest & Woodland Class of the NVCS applies to the majority of polygons and area covered by types in the NVCS, with 6,325 polygons (71.2% of natural/semi-natural polygons, having an average polygon size of 3.4 ha) covering 21,741.6 ha (81.1% of area covered by the NVCS types). As for area, the Forest & Woodland Class is largely dominated by the North-Central Beech - Maple - Basswood - Oak Forest Group (G021), covering 10,507.9 ha (48.3%). This forest group contains just one map class (recognizing one association type), the Beech - Maple - Northern Hardwoods Forest (FBM). These forests tend to be large in size. With just 902 polygons (14.3% of the Forest & Woodland Class polygons), the average area per polygon is 11.6 ha, exceeding all other averages of map classes within the Forest & Woodland Class by three times or more. In contrast, the Northern Hardwood - Hemlock - White Pine Forest Group (G163), albeit covering almost half as much area than G021 (5,798.3 ha or 26.7% of the Forest & Woodland Class), has over two and a half times the number of polygons (2,437 polygons or 38.5% of the Forest & Woodland Class). Although G163 contains eight map classes (three of which are map-class phases of one association type), two dominate this group in both polygon frequency and area; the Northern Red Oak - Sugar Maple Forest (FOM) consisting of 769 polygons (31.6% of G163 polygons) covering 2,882.5 ha (49.7% of area covered by G163) and the Aspen - Birch - Red Maple Forest (FBR), consisting of 673 polygons (27.6% of G163 polygons) covering 1,468.2 ha (25.3% of area covered by G163). From this quick analysis, we begin to see that SLBE is largely made up of upland hardwood forests.

The Shrubland & Grassland Class of the NVCS applies to 2,536 polygons (28.5% of natural/semi-natural polygons, having an average polygon size of 2.0 ha) covering 5,001.8 ha (18.7% of area covered by the NVCS types). The Great Lakes Dune Grassland & Shrubland Group (G089) is most common within this class, with 970 polygons (38.2% of the Shrubland & Grassland Class polygons) covering 2,490.2 ha (50.1% of area covered by the Shrubland & Grassland Class). With regards to area, G089 is largely dominated by the Great Lakes Beachgrass Dune (HAB) map class, covering 1,542.4 ha (61.9% of area); however, with regards to polygon frequency, the Great Lakes Juniper Dune Shrubland (DJD) map class has a higher frequency of polygons than does HAB, yet DJD covers a considerably smaller area. There are 296 polygons of DJD, having an average polygon size of 1.6 ha, compared to 240 polygons of HAB, having an average polygon size of 6.4 ha. There are 460.6 ha (18.5% of area covered by G089) of DJD.

Within the Shrubland & Grassland Class, the Northern & Central Ruderal Meadow & Shrubland Group (G059) is almost as common in both frequency of polygon and area covered than is G089, with G059 having 840 polygons (33.1% of Shrubland & Grassland Class polygons) and covering 1,921.1 ha (38.4% of the area covered by the Shrubland & Grassland Class). This high frequency and area is largely due to the Ruderal Grassland (HMX) map class within G059, consisting of 669 polygons covering 1,646.0 ha. Shrub and herbaceous wetlands of the Shrubland & Grassland Class consist of 703 polygons (27.7% of the Shrubland & Grassland Class polygons) covering 569.4 ha (11.5% of area covered by the Shrubland & Grassland Class).

The Aquatic Vegetation Class consists of the Eastern North American Freshwater Aquatic Vegetation Group (G114), which consists of 25 polygons (0.3% of natural/semi-natural polygons, having an average polygon size of 3.0 ha) covering 31.8 ha (0.1% of area covered by the NVCS types).

Non-vegetation land cover features (those not in the NVCS) consist of only 85 polygons (0.9% of all polygons) in total but cover 5,499.6 ha (16.3% of the entire area). The average polygon size for map classes representing non-vegetation features (on average 64.7 ha.) is considerably larger than that of map classes representing NVCS types. The larger polygon size of the non-vegetation classes is primarily due to the surface water jurisdiction into Lake Michigan and other large lakes included in the project boundary. Of the map classes representing non-vegetation features, the Open Water Lake (NWL) map class (with only 30 polygons but an average polygon size of 175.9 ha) dominates in area (5,275.7 ha or 95.9% of the non-vegetation area).

The cultural landscape classified in the NVCS consists of 325 polygons (3.5% of all polygons) and covers 1,465.9 ha (4.3% of the entire area). The average polygon size is 4.5 ha. The Developed Vegetation Cultural Class (consisting of one map class) has about twice the number of polygons and covers almost three times the area than does the Agricultural Vegetation Cultural Class (consisting of three map classes).

Considerably more analyses and deductions can be attained even from these simple summary reports. Other summary tables can be derived from the map layer of localized areas (e.g., the SLBE lands excluding the environs) by clipping the map layer to its desired location and running a new summary. Also, more complex summary reports can be derived, either from the map layer alone (e.g., employing physiognomic modifiers such as coverage, pattern, and height) or from introducing other spatial-data layers (e.g., soils, geology, invasive species, animal distribution, historical land use). By performing various modifications to the vegetation map layer, one can make further deductions regarding vegetation and its ecology.

Map Layer Presentation

Figure 17 presents the map layer produced for the SLBE vegetation mapping project. The finest level of the map (the map-attribute codes consisting of map classes and physiognomic modifiers) is too detailed to present; therefore, the map in Figure 17 is generalized, collapsing map classes at the group level of the NVCS.

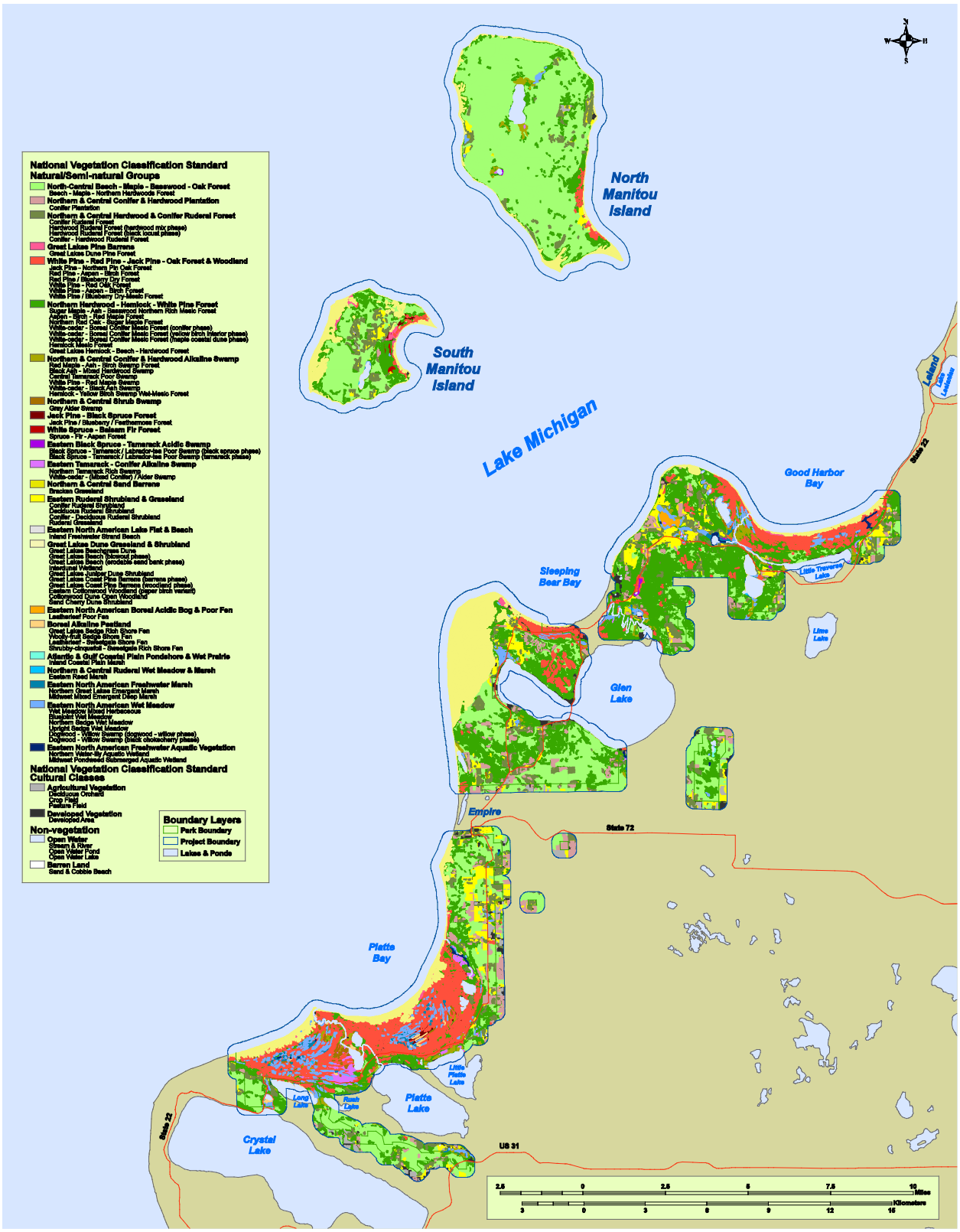


Figure 17. Vegetation of Sleeping Bear Dunes National Lakeshore (Michigan) and environs, presented at the natural/semi-natural group and the cultural class levels of the National Vegetation Classification Standard, Version 2 (FGDC 2008).

Accuracy Assessment

Methods

Purpose

The objective of an accuracy assessment (AA) is to measure the probability that a particular location has been assigned its correct vegetation type. An AA estimates thematic errors in the data, giving users information needed to determine data suitability for a particular application. At the same time, data producers are able to learn more about the nature of errors in the data. Thus, the two views of an AA are "producers' accuracy," which is the probability that an AA point has been mapped correctly (also referred to as an error of omission), and "users' accuracy," which is the probability that the map actually represents what was found on the ground (also referred to as error of commission). Both producers' and users' accuracies can be obtained from the same set of data by using different analyses. Errors occur when map classes are not the same as the classes observed in the field. A major assumption of AA is that the process of mapping and the process of the assessment (e.g., the application of the classification system) are identical, so that a "false error" is not detected because of procedural differences. In actuality, the process of AA is based on field observance, and the process of mapping is based on aerial photointerpretation with different perspectives of scale and observation.

Sampling Design

We used a stratified random sampling approach to select AA sites at Sleeping Bear Dunes National Lakeshore (SLBE). We included all map classes representing natural/semi-natural floristic vegetation types[4] in the National Vegetation Classification Standard (NVCS) as the individual themes to randomly select sites. Map-class phases were collapsed into the map class they belonged to. (Recall that a map-class phase is a version of a vegetation type recognizable in mapping and is important for either management or ecological interests.) All locations within the SLBE having public access were included in the sampling design.

The number of samples needed for each map class (theme) was determined by using National Park Service (NPS) Vegetation Inventory Program (VIP) recommendations for a medium-sized park (TNC et al. 1994), as suggested in the following scenarios:

- Scenario A: The class is abundant. It covers more than 50 ha of the total area and consists of at least 30 polygons. The recommended sample size is 30.
- Scenario B: The class is relatively abundant. It covers more than 50 ha of the total area but consists of fewer than 30 polygons. The recommended sample size is 20. The rationale for reducing the sample size for this type of class is that sample sites are more difficult to find because of the lower frequency of the class.
- Scenario C: The class is relatively rare. It covers less than 50 ha of the total area but consists of more than 30 polygons. The recommended sample size is 20. The rationale for reducing the sample size is that the class occupies a small area. At the same time, however, the class consists of a considerable number of distinct polygons that are

[4] Map classes representing ruderal vegetation were classified at the group level in the NVCS and were not included in the AA sampling design (because of the inherent variability in vegetation), with one exception—the Wet Meadow Mixed Herbaceous (HWM) map class (which was classified as the Eastern North American Wet Meadow Group [G112] in the NVCS).

possibly widely distributed. The number of samples, therefore, remains relatively high because of the high frequency of the class.

- Scenario D: The class is rare. It has more than five but fewer than 30 polygons and covers less than 50 ha of the area. The recommended number of samples is five. The rationale for reducing the sample size is that the class consists of small polygons and the frequency of the polygons is low. Specifying more than five sample sites would, therefore, probably result in multiple sample sites being sampled within the same (small) polygon. Collecting samples at five sites will allow for an accuracy estimate to be computed, although it will not be very precise.
- Scenario E: The class is very rare. It has fewer than five polygons and occupies less than 50 ha of the total area. In this case, it is recommended that the existence of the class be confirmed by a visit to each sample site. The rationale for this recommendation is that with fewer than five sample sites (assuming one site per polygon), no estimate of the level of confidence can be established for the sample (the existence of the class can only be confirmed through field checking).

The recommendations above take into account both the statistical and operational aspects of sampling. The accuracy estimate associated with rare classes cannot be stated with the same level of confidence as with more abundant classes. For example, with a sample size of five, the level of error in the estimate is closer to 25% at a 90% confidence level, as opposed to 10% with a sample size of 27. This has implications for our ability to accept a given point estimate as meeting accuracy requirements. Whether or not a given accuracy estimate is accepted as one that meets accuracy requirements depends on the width of the confidence interval associated with the point estimate and the outcome of a hypothesis test that determines if a given point estimate is equivalent to or exceeds requirements.

We used the above guidelines in selecting the appropriate number of sites for each map class. A 10-m buffer was applied interior to the polygon boundaries to promote global positioning system (GPS) navigation into the correct polygon. Random AA points (coordinates) were generated for each map class by using Hawth's Tools for ArcGIS (Beyer 2004). The AA points were then assigned a random number used to identify each AA site location.

We equipped the field crews with several tools to maximize their ability to accurately locate each AA site. We plotted 1:12,000-scale, hard-copy maps showing locations of the AA sites, the unlabelled polygon boundaries of the vegetation map, and the project boundary with the color-infrared aerial photomosaic displayed as a background. The AA-site coordinates were uploaded into GPS receivers and then projected in Universal Transverse Mercator (UTM), Zone 16, by using the North American Datum of 1983 (NAD83).

Field Data Collection

Once an AA site was reached by using the tools described above, an area equal to the size of a minimum mapping unit (MMU) within the map polygon was to be evaluated (Figure 18). Using the field key, the field crews determined the appropriate vegetation type. The field crews also recorded the GPS coordinate location in the field, dominant species, environmental data, and pertinent comments. For a sample data sheet, refer to Appendix F: Accuracy Assessment Form.

If the area was not homogeneous (containing more than one vegetation type), the other appropriate vegetation types were also listed on the data sheet.



Figure 18. A field botanist collecting data at an accuracy assessment site for the analysis of the feature-class layer of the vegetation map produced during the Sleeping Bear Dunes National Lakeshore (Michigan) vegetation mapping project.

Data Analyses

Field data for 1,024 AA sites were collected and entered into the NPS PLOTS Database Version 2 (NatureServe 2005). The database was subsequently reviewed for data entry errors. Analyses of map accuracy included the following steps:

- Initial comparative analysis of the field and map data,
- Review of all disagreements and correction of false errors as necessary,
- Final comparative analysis of the field and map data,
- Individual map-class analysis,
- Final output of results into a contingency matrix, and
- Final output of the analyses and results into a spatial database for use in a GIS.

Initial Comparative Analysis

We completed a spatial join of the AA field-site data and the map-polygon data. This allowed us to compare each AA field-site call (vegetation type) to the corresponding map-polygon call (map class representing a vegetation type). We used Microsoft Excel 2007 (Microsoft Corporation) to compare and tabulate the field-site call to the map-polygon call. Our comparison accounted for

alternate field calls indicated on the field data sheets, accepting map-polygon calls as correct when matching these alternate calls.

Review of Disagreements

All mismatches (disagreements) were subsequently reviewed for false errors. A false error is defined as a mismatch between the AA field-site call and the map-polygon call if caused by an accuracy error in the GPS field-site coordinates, a missing or misapplied field-site call, or a field-site assessment of an area smaller than the MMU (an inclusion). This review process involved looking at the AA sites and their corresponding polygons by using ArcGIS (Version 9.3, © 2008 Environmental Systems Research Institute, Redlands, California) to locate them and by then viewing them on aerial photographs with a Topcon (MS-3) mirror stereoscope with 3x binoculars. We also reviewed the field data sheet to gain fuller context of the ground data. From this process, we determined whether an initial disagreement was either a true error or indeed a match. The following paragraphs explain our process further:

Spatial Error

A spatial error might occur in one of two of the following ways: (1) the GPS device acquired inaccurate field coordinates or (2) a geospatial error existed within the vegetation map layer (called a "map-layer shift"). Either of these spatial errors could displace the newly acquired field coordinate inside an adjacent polygon on the map layer. From selecting sites more than 10 m from polygon edges, we were able to minimize spatial errors in GPS coordinates, yet occasionally GPS accuracy could fall outside this parameter.

Questionable Field Call

A field assessment call might be questioned during the analysis, especially when the perspective from the ground was limited by poor vantage points, such as heavy cover of vegetation or wet soils preventing the field worker from walking around the MMU. If the MMU area was diverse, with more than one map class represented, it was possible to miss or not recognize other vegetation types present. We reviewed these situations by checking the aerial photographs for diversity at the site and by reviewing the field data sheets to check for possible problems. We also reviewed the data for the possibility of an incorrect vegetation class or another vegetation class not having been recorded. Thus, we were able to update our analysis tables to reflect any additions or changes to the field-site call in preparation for the second comparative analysis. (We also updated the PLOTS Database.)

Inclusion

The area assessed in the field during the AA might fall below the MMU for mapping (termed an inclusion). We discovered several instances wherein, after reviewing the aerial photographs, we could conclude that the site in question contained vegetation that was an inclusion to the surrounding map class. Certain vegetation features can be quite distinct from each other on aerial photographs (e.g., open woodland versus dense forest), allowing easy assessment of site inclusions in the lab. Another type of inclusion occurred when an area in the field was a valid MMU, but the assessed area overlapped into an adjacent polygon. Particularly in the case of smaller polygons adjacent to those having similar vegetation types, it was sometimes difficult to determine if the assessed area actually fell within the intended polygon.

Final Comparison

Of the 1,024 AA sites originally collected, we dropped 8 sites because of problems with the data (e.g., missing UTM coordinates, unrectifiable spatial errors, or incomplete data). We used the remaining 1,016 AA sites for the final comparative analysis of the vegetation map layer (Figure 19).

Individual Map Class Analysis

For individual map-class accuracies falling below standards of the NPS VIP, we compared map classes to determine which were in confusion. If a repetitive confusion was evident, we then determined whether to merge the map classes to gain higher accuracy or to leave the map classes as they were, even if it resulted in lower accuracy. These determinations were made with input from NPS staff (SLBE and Great Lakes Inventory & Monitoring Network).

Final Output

The results of the final analyses were transferred into a contingency table (matrix) where we calculated percentages of users' and producers' accuracies for each map class. The matrix shows both the frequency of agreement and placement of disagreements.

AA Spatial Database

For use in a GIS, we produced a feature-class layer of the AA site locations, along with supporting tables, and incorporated them into the geodatabase for the SLBE vegetation mapping project. The field data for AA are also included in the PLOTS Database.

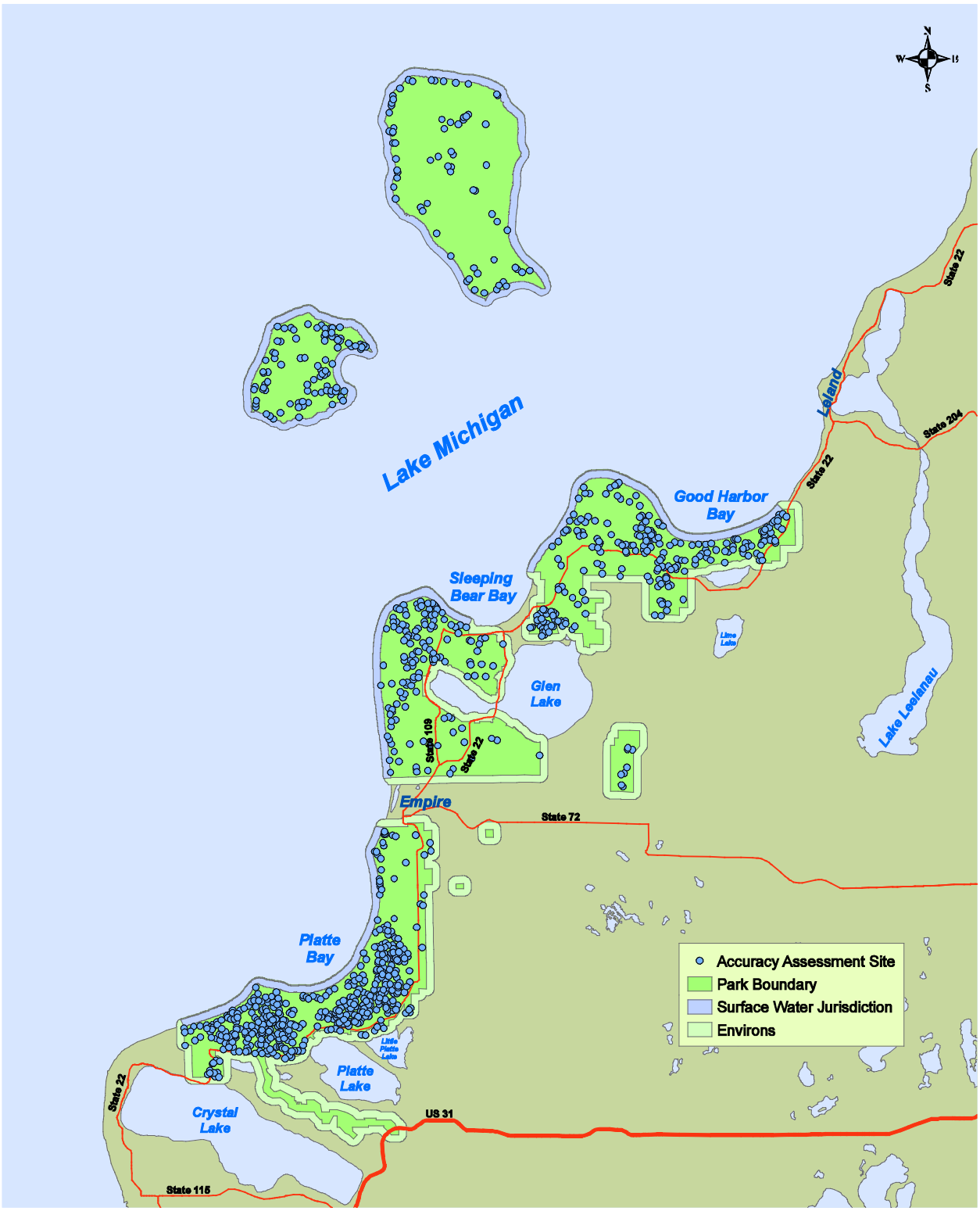


Figure 19. Locations of accuracy assessment sites used to validate the vegetation map layer for the Sleeping Bear Dunes National Lakeshore (Michigan) vegetation mapping project.

Results

Overall accuracy is 77.8% for primary map classes representing natural/semi-natural vegetation floristic types in the NVCS. A kappa adjustment for chance agreements resulted in a final overall accuracy of 76.7%. The contingency matrix for AA results is provided in Appendix G: Accuracy Assessment Contingency Table. The matrix shows the accuracy of each map class (along with 90% confidence intervals), with the users' accuracy reflecting errors of inclusion (commission errors) and producers' accuracy reflecting errors of exclusion (omission errors). The width of each confidence interval is affected by the sample size used to derive the point estimate.

Our overall AA fell short of the accuracy requirement of 80% established by the NPS VIP; however, this level of accuracy was determined by the NPS as an output nevertheless useful to users of the vegetation database layer. The most important factors affecting accuracy were disagreements about the relative densities of conifers to deciduous trees, difficulties distinguishing conifer species from one another (and their densities) and wet herbaceous species from one another (and their densities), difficulties recognizing black ash, and overly generalized mapping. Some individual accuracies did not meet the 80% requirement (taking into account 90% confidence intervals). In general, errors of commission (users' accuracy) occurred in fewer map classes than did errors of omission (producers' accuracy). The following are map classes for which the mapping project did not meet the required rates of accuracy, in terms of either the actual percentage or the confidence intervals.

Users' Accuracy (Errors of Commission)

Initial results from the assessment sites for three similar wetland forest map classes—White-cedar - (Mixed Conifer) / Alder Swamp (FCS), Black Ash - Mixed hardwood Swamp (FBA), and White-cedar - Black Ash Swamp (FCA)—were combined for the analysis because the individual accuracies for each fell below 55%. Many of the errors of one map class were missed to one of the other two. By combining the sites, the users' accuracy improved to 66%, with a 90% confidence interval of 57–75%. (Note that the individual polygons and codes of each map class are retained in the vegetation polygon layer). Of the 89 polygons mapped as one of these three wetland-forest map classes, 30 AA sites were found to contain different vegetation types, with errors attributed as follows:

- Of two Hemlock - Yellow Birch Swamp Wet-Mesic Forest (FHS) sites, one was mapped as FBA, and one was mapped as FCA;
- One Beech - Maple - Northern Hardwoods Forest (FBM) site was mapped as FBA;
- Of five Red Maple - Ash -Birch Swamp Forest (FRM) sites, three were mapped as FBA, and one was mapped as FCA;
- One Northern Tamarack Rich Swamp (FTR) site was mapped as FCS;
- Two Northern Tamarack Poor Swamp (FTS) sites were both mapped as FCS;
- One White-cedar - Boreal Conifer Mesic Forest (as the yellow birch interior phase, FCB) site was mapped as FCS;
- Of two White Pine - Red Maple Swamp (FWS) sites, one was mapped as FCS, and one was mapped as FBA;
- Of nine Gray Alder Swamp (SAS) sites, three were mapped as FBA, four were mapped as FCA, and two were mapped as FCS;
- One Dogwood - Willow Swamp (SDW/SBC) site was mapped as FBA;

- Two Leatherleaf Poor Fen (DLF) sites were mapped as FCS;
- One Wet Meadow Mixed Herbaceous (HWM) site was mapped as FBA;
- One Northern Sedge Wet Meadow (HSG) site was mapped as FBA;
- One Northern Great Lakes Emergent Marsh (HEM) site was mapped as FBA;
- One Midwest Pondweed Submerged Aquatic Wetland (HSV) site was mapped as FBA.

Of the errors described above, almost half were mapped as FBA. The signature for FBA proved difficult for the interpreter; often dead trees were mistaken for leaf-off black ash trees. Other errors occurred because the AA crews did not find a high enough density of trees to meet the criteria of forest types, or alternatively, the composition of trees was not dominated by black ash or northern white-cedar.

The users' accuracy for the Dogwood - Willow Swamp map class (dogwood - willow phase [SDW] and black chokeberry phase [SBC]) was 46%, with a 90% confidence interval of 29–64%. Of the 30 polygons mapped as SDW/SBC, 15 AA sites within those polygons were found to have different vegetation types, with errors attributed as follows:

- Of two White-cedar - Black Ash Swamp (FCA) sites, one was mapped as SDW and one was mapped as SBC;
- One White Pine -Red Maple Swamp (FWS) site was mapped as SDW;
- Of nine Specked Alder Swamp (SAS) sites, seven were mapped as SDW, and two were mapped as SBC;
- One Northern Sedge Wet Meadow (HSG) site was mapped as SDW;
- One Great Lakes Sedge Rich Sore Fen (HEM) site was mapped as SDW;
- One Wiregrass Sedge Shore Fen (HSS) site was mapped as SDW.

Errors in mapping the Dogwood - Willow Swamp association type were caused by a misinterpretation of other wetland shrub species (particularly common winterberry and alders) mixed within these sites, or by a disagreement in the density of trees.

Initial results from the assessment sites for two wetland herbaceous map classes—Wet Meadow Mixed Herbaceous (HWM) and Bluejoint Wet Meadow (HCC)—were combined for the analysis because individual accuracies for each fell below 55%, and the two types were often confused with each another. By combining the sites, the accuracy improved to 61% from 39% for HWM and 55% for HCC, with a confidence interval of 49–73%. Of the 51 polygons mapped as HWM and HCC, 20 AA sites within those polygons were found to contain different vegetation types, with errors attributed as follows:

- One Cottonwood Dune Open Woodland (WCD) site was mapped as HWM;
- Two Dogwood - Willow Swamp (as the dogwood - willow phase, SDW) sites were mapped as HWM;
- Two Great Lakes Beachgrass Dune (HAB) sites were mapped as HCC;
- Two Interdunal Wetland (HDW) sites were mapped as HCC;
- Of four Northern Sedge Wet Meadow (HSG) sites, two were mapped as HCC, and two were mapped as HWM;
- One Great Lakes Sedge Rich Shore Fen (HSM) site was mapped as HWM;

- Four Northern Great Lakes Emergent Marsh (HEM) sites were mapped as HCC;
- Of three Wiregrass Shore Fen (HSS) sites, one was mapped as HWM, and two were mapped as HCC;
- One Northern Water-lily Aquatic Wetland (HFA) site was mapped as mapped as HWM.

Errors in mapping the HWM and HCC types were primarily caused by confusion between wetland herbaceous signatures. A few polygons were partly in shadow, making it difficult to see the signatures. The error in mapping the Dogwood - Willow Swamp type with the HWM map class was caused by the shrubs being too short to adequately interpret them as a shrub type. The error in mapping the WCD type with the HWM map class was caused by misinterpreting the density of trees and the understory composition.

Producers' Accuracy (Errors of Omission)

The producers' accuracy for the Hemlock - Yellow Birch Swamp Wet-Mesic Forest (FHS) map class was 29%, with a 90% confidence interval of -7–64%. Of the seven AA sites classified in the field as FHS, five sites fell within polygons that were mapped as other vegetation types, with errors attributed as follows:

- One polygon was mapped as Black Ash - Mixed Hardwood Swamp (FBA);
- One polygon was mapped as White-cedar - Black Ash Swamp (FCA);
- One polygon was mapped as White-cedar - Boreal Conifer Mesic Forest (yellow birch interior phase, FCB);
- One polygon was mapped as Great Lakes Hemlock - Beech - Hardwood Forest (FHB);
- One polygon was mapped as White Pine - Red Maple Swamp (FWS).

The errors in not mapping the FHS type were caused by misinterpreting hemlock for other conifers, such as northern white-cedar and eastern white pine, or from mapping too broadly above the set MMU standard.

The producers' accuracy for the White Pine - Red Oak Forest (FWO) map class is 55%, with a 90% confidence interval of 42–68%. Of the 47 AA sites classified in the field as FWO, 21 sites fell within polygons that were mapped as other vegetation types, with errors attributed as follows:

- Two polygons were mapped as Jack Pine / Blueberry Dry Forest (FJB);
- Four polygons were mapped as Red Pine - Aspen - Birch Forest (FRA);
- Six polygons were mapped as Red Pine Forest (FRP);
- Two polygons were mapped as White Pine - Aspen Forest (FWA);
- Three polygons were mapped as White Pine Forest (FWP);
- One polygon was mapped as Northern Red Oak - Sugar Maple Forest (FOM);
- One polygon was mapped as Jack Pine - Northern Pin Oak Forest (FJO);
- One polygon was mapped as White-cedar - Boreal Conifer Mesic Forest (yellow birch interior phase, FCB);
- One polygon was mapped as White-cedar - Boreal Conifer Mesic Forest (conifer phase, FCC).

The errors in not mapping the FWO type were caused by overestimating the percentages of the deciduous component, by mapping the deciduous component as aspen instead of oak, or by misinterpreting the conifer species.

The producers' accuracy for the Jack Pine - Northern Pin Oak Forest (FJO) map class is 44%, with a 90% confidence interval of 12–77%. Of the nine AA sites classified in the field as FJO, five sites fell within polygons that were mapped as other vegetation types, with errors attributed as follows:

- Two polygons were mapped as Jack Pine / Blueberry / Feathermoss Forest (FJB);
- Two polygons were mapped as Red Pine / Blueberry Dry Forest (FRP);
- One polygon was mapped as White Pine Forest (FWP).

The errors in not mapping the FJO type were caused by overestimating the percentage of deciduous trees in the canopy or by misinterpreting the density relationships between the pine species.

The producers' accuracy for the Gray Alder Swamp (SAS) map class was 54%, with a 90% confidence interval of 41–67%. Of the 48 AA sites classified in the field as SAS, 22 sites fell within polygons that were mapped as other vegetation types, with errors attributed as follows:

- One polygon was mapped as Black Spruce - Tamarack / Labrador Tea Poor Swamp (black spruce phase, FSS);
- Three polygons were mapped as Black Ash - Mixed hardwood Swamp (FBA);
- Four polygons were mapped as White - cedar - Black Ash Swamp (FCA);
- Two polygons were mapped as White-cedar - Mixed Conifer) / Alder swamp (FCS);
- One polygon was mapped as Black Spruce - Tamarack / Labrador-tea Poor Swamp (tamarack phase, FTP);
- Seven polygons were mapped as Dogwood - Willow Swamp (dogwood - willow phase, SDW);
- Two polygons were mapped as Dogwood - Willow Swamp (black chokeberry phase, SBC);
- Two polygons were mapped as Shrubby-cinquefoil - Sweetgale Rich Shore Fen (SSF);
- One polygon was mapped as Leatherleaf Poor Fen (DLF).

The errors in not mapping the SAS type were caused by overestimating the percentage of forest trees, such as black ash, black spruce, northern white-cedar, or tamarack, and by misinterpreting alder for dogwood, willow, or other wetland shrubs.

The producers' accuracy for the Dogwood - Willow Swamp map class (dogwood - willow phase [SDW] and black chokeberry phase [SBC]) was 60%, with a 90% confidence interval of 42–78%. Of the 25 AA sites classified in the field as SDW/SBC, 10 sites fell within polygons that were mapped as different vegetation types, with errors as follows:

- One polygon was mapped as FBA, Black Ash - Mixed hardwood Swamp (FBA);
- One polygon was mapped as Aspen - Birch - Red Maple Forest (FBR);

- One polygon was mapped as Sand Cherry Dune Shrubland (SCW);
- Two polygons were mapped as Gray Alder Swamp (SAS);
- Two polygons were mapped as Leatherleaf Poor Fen (DLF);
- Two polygons were mapped as Wet Meadow Mixed Herbaceous (HWM);
- One polygon was mapped as Great Lakes Sedge Rich Shore Fen (HSM).

The errors in not mapping the Dogwood - Willow Swamp type were caused by overestimating the percentage of forest trees, misidentifying the shrub species, or underestimating the percentage of shrubs present.

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Appendix A: Plot Sampling Form

NATIONAL PARK VEGETATION MAPPING PROGRAM: PLOT SURVEY FORM

IDENTIFIERS/LOCATORS

Plot Code_____ Polygon Code_____

Provisional CommunityName_____

State____ Park Name_____ Park Site Name_____

Quad Name_____ Quad Code_____

GPS file name_____ Field UTM X__ __ __ __ __ __ m E Field UTM Y__ __ __ __ __ __ __ m N

Waypoint_____ Zone_____ Datum_____ Error +/-_____ m Elevation_____

please do not complete the following information when in the field

Corrected UTM X___ ___ ___ ___ ___ ___ m E Corrected UTM Y___ ___ ___ ___ ___ ___ ___ m N

Survey Date_____ Surveyors_____

Directions to Plot:

Plot length____ (m) Plot width____ (m) Camera_____ Number of images____ Time of Photos_____

Plot representativeness:

Is the surrounding ~1 hectare area all the same? ___yes ___no

Please draw a map of plot here with plot shape,
where plot photos were taken, potential community
boundary breaks, and important landmarks.

ENVIRONMENTAL DESCRIPTION

Slope_____Aspect_____

Topographic Position

Landform

Surficial Geology

Cowardian System
___Upland
___Riverine
___Palustrine
___Lacustrine

Non-Tidal
___Permanently Flooded
___Semipermanently Flooded
___Seasonally/Temporarily Flooded
___Saturated
___Seasonally Flooded/Saturated
___Intermittently Flooded

Environmental Comments:	Soil Taxon/Description
	Unvegetated Surface: *(percent – total should equal 100%)* ___Bedrock ___Litter, duff ___Wood (> 1 cm) ___Large rocks (cobbles, boulders > 10 cm) ___Small rocks (gravel, 0.2-10 cm) ___Sand (0.1-2 mm) ___Bare soil ___Other:_____
Soil Texture ___sand ___loamy sand ___sandy loam ___loam ___silt loam ___silt ___clay loam ___silty clay ___silty clay loam ___clay ___peat ___muck	Soil Drainage ___Rapidly drained ___Well drained ___Moderately well drained ___Somewhat poorly drained ___Poorly drained ___Very poorly drained

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic class	Cover Scale for Strata		Height Scale for Strata	
<u>Trees and Shrubs</u>		___Forest	P	5%		
___Evergreen	___Broad-leaved	___Woodland	01	10%	01	<0.5 m
___Cold-deciduous	___Needle-leaved	___Shrubland	02	20%	02	0.5-1m
___Drought-deciduous	___Mixed Needle-leaved - Broad-leaved	___Dwarf Shrubland	03	30%	03	1-2 m
___Mixed evergreen - cold-deciduous	___Microphyllous	___Herbaceous	04	40%	04	2-5 m
	___Graminoid	___Nonvascular	05	50%	05	5-10 m
___Mixed evergreen - drought-deciduous	___Forb	___Sparsely Vegetated	06	60%	06	10-15 m
<u>Herbs</u>	___Pteridophyte		07	70%	07	15-20 m
___Annual			08	80%	08	20-35 m
___Perennial			09	90%	09	35-50 m
			10	100%	10	>50 m

Strata	Height Class	Cover Class	Diagnostic species (if known)
T1 Emergent	_____	_____	_____
T2 Canopy	_____	_____	_____
T3 Sub-canopy	_____	_____	_____
S1 Tall shrub	_____	_____	_____
S2 Short Shrub	_____	_____	_____
S3 Dwarf-Shrub	_____	_____	_____
H Herbaceous	_____	_____	_____
A1 FltngLvdAquatic	_____	_____	_____
A2 Submerged Aquatic	_____	_____	_____
N Non-vascular	_____	_____	_____
V Vine/liana	_____	_____	_____
E Epiphyte	_____	_____	_____

please see above table for height and cover scales

Animal Use Evidence

Natural and Anthropogenic Disturbance Comments:

Overall Qualitative Assessment:

Plot Code ____

Species/percent cover: Starting with the uppermost stratum, list all species with cover class for each species in the stratum. For forests and woodlands, on a separate line below each tree species, list the DBH of all trees above 10 cm diameter. Separate measurements with a comma. Put an asterisk next to any species that are known diagnostics for a particular community in the classification.

Stratum	Species Name	Cover Class	Stratum	Species Name	Cover Class

Cover Scale for Species: T=<1%; P=1-5%; 01=5-15%; 02=15-25%; 03=25-35%; 04=35-45%; 05=45-55%; 06=55-65%; 07=65-75%; 08=75-85%; 09=85-95%; 10=>95%

Appendix B: Descriptions of Vegetation Types

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U.S. NATIONAL VEGETATION CLASSIFICATION

Associations of
Sleeping Bear Dunes National Lakeshore

10 November 2010

by

NatureServe

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This subset of the International Ecological Classification Standard covers vegetation associations attributed to Sleeping Bear Dunes National Lakeshore. This classification has been developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. Comments and suggestions regarding the contents of this subset should be directed to Mary J. Russo, Central Ecology Data Manager, Durham, NC <mary_russo@natureserve.org> and Jim Drake, Regional Vegetation Ecologist, Minneapolis, MN <jim_drake@natureserve.org>.

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Citations:

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1. Forest & Woodland

1.C.2. Cool Temperate Forest

1.C.2.Na. Eastern North American Cool Temperate Forest

M153. Central Mesophytic Hardwood Forest

G021. North-Central Beech - Maple - Basswood - Oak Forest Group

Beech - Maple - Northern Hardwoods Forest

***Acer saccharum* - *Fagus grandifolia* - *Betula* spp. / *Maianthemum canadense* Forest**
Sugar Maple - American Beech - Birch species / Canada Mayflower Forest
Identifier: CEGL005004

NVC CLASSIFICATION

Division	Eastern North American Cool Temperate Forest (1.C.2.Na)
Macrogroup	Central Mesophytic Hardwood Forest (M153)
Group	North-Central Beech - Maple - Basswood - Oak Forest Group (G021)
Association (Common name)	Beech - Maple - Northern Hardwoods Forest
Ecological System(s):	Laurentian-Acadian Northern Hardwood Forest (CES201.564)
	North-Central Interior Beech-Maple Forest (CES202.693)

ELEMENT CONCEPT

Global Summary: This northern hardwoods forest is found in the central Great Lakes area of the United States and Canada. Stands occur on flat to moderately sloping terrain on glacial features such as till or moraines. Soil textures range from sands to loams and are mesic, nutrient-rich, and deep. A relatively thick layer of fallen leaves covers the forest floor. The tree canopy is dense and, after the trees leaf-out, the forest floor is under heavy shade. This community is dominated by two hardwood species, *Acer saccharum* (sugar maple) and *Fagus grandifolia* (American beech). Common associates include *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Fraxinus americana* (white ash), *Quercus rubra* (northern red oak), and *Tilia americana* (American basswood). Shrubs are widely scattered, and include *Lonicera canadensis* (American fly honeysuckle), *Ribes* (currant) spp., *Sambucus racemosa* var. *racemosa* (red elderberry), and *Viburnum acerifolium* (mapleleaf viburnum). Many of the herbaceous species are spring ephemerals which bloom before the tree leaves are fully formed. Among the common herbaceous species are *Adiantum pedatum* (northern maidenhair), *Arisaema triphyllum* (Jack in the pulpit), *Botrychium virginianum* (rattlesnake fern), *Lycopodium* (clubmoss) spp., *Maianthemum canadense* (Canada mayflower), *Maianthemum stellatum* (starry false lily of the valley), *Polygonatum pubescens* (hairy Solomon's seal), *Trillium grandiflorum* (snow trillium), and *Viola* (violet) spp.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This common beech - maple - northern hardwoods forest was sampled at ten locations in the park. Sites include low and midslope hills with variable slope and aspect, flat lakeplains, and gentle east-facing low slope moraines and back dunes often with some rolling microtopography. Soils are moderately well- to well-drained loamy sand and sandy loam. The unvegetated surface is dominated by leaf litter (66-97% cover) with some wood (2-30%), bare soil (0-5%), dead plant stems (1-25%) and mosses (0-2%). Evidence of disturbance includes trails, Lepidopteran larvae infestation, dead standing and fallen trees, and the presence of exotic plants.

Global Environment: Stands occur on flat to moderately sloping terrain on glacial features such as till or moraines. Soil textures range from sandy loams to loams in Wisconsin (Kotar and Burger 1989) to sandy soils in northern Lower Michigan (Cleland et al. 1994). The soils are usually mesic, nutrient-rich, and deep. A relatively thick layer of fallen leaves covers the forest floor (Kotar and Burger 1989, Host and Pregitzer 1991).

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The moderate to very dense (50-90% cover) tree canopy, 15-35 m tall, is codominated by *Acer saccharum* (sugar maple) and *Fagus grandifolia* (American beech) and may include *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Fraxinus americana* (white ash), *Quercus rubra* (northern red oak), and others. The very sparse to moderately dense (5-70%) subcanopy (5-20 m) is made up of canopy species, as is the very sparse to moderately dense (5-70%) tall-shrub layer (2-5 m) which may also include *Abies balsamea* (balsam fir), *Acer pensylvanicum* (striped maple), *Thuja occidentalis* (northern white-cedar), and *Tsuga canadensis* (eastern hemlock). The very sparse (5-30%) short-shrub layer (0.5-2 m) includes saplings of previously mentioned species as well as *Acer spicatum* (mountain maple), *Cornus alternifolia* (alternateleaf dogwood), *Lonicera canadensis* (American fly honeysuckle), *Ostrya virginiana* (hophornbeam), *Sambucus racemosa* (red elderberry), and *Viburnum acerifolium* (mapleleaf viburnum). The very sparse to total (5-100%) herbaceous layer includes many tree seedlings along with *Aralia nudicaulis* (wild sarsaparilla), *Aralia racemosa* (American spikenard), *Arisaema triphyllum* (Jack in the pulpit), *Carex communis* (fibrousroot sedge), *Epifagus virginiana* (beechdrops), *Hepatica nobilis* var. *acuta* (sharplobe hepatica), *Maianthemum canadense* (Canada mayflower), *Mitchella repens* (partridgeberry), *Osmorhiza claytonii* (Clayton's sweetroot), *Polygonatum pubescens* (hairy Solomon's seal), *Thalictrum dioicum* (early meadowrue), *Trientalis borealis* (starflower), *Uvularia grandiflora*

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(largeflower bellwort), *Viola canadensis* (Canadian white violet), and others. In addition, this community supports state-vulnerable *Panax quinquefolius* (American ginseng).

Global Vegetation: The tree canopy is dense, and after the trees leaf out, the forest floor is under dense shade. This community is dominated by two hardwood species, *Acer saccharum* (sugar maple) and *Fagus grandifolia* (American beech). *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Fraxinus americana* (white ash), *Quercus rubra* (northern red oak), and *Tilia americana* (American basswood) are common associates. Shrubs are widely scattered and include *Lonicera canadensis* (American fly honeysuckle), *Ribes* (currant) spp., *Sambucus racemosa* var. *racemosa* (red elderberry), and *Viburnum acerifolium* (mapleleaf viburnum). Many of the herbaceous species are spring ephemerals which bloom before the tree leaves are fully formed (Thompson 1984). Among the common herbaceous species are *Adiantum pedatum* (northern maidenhair), *Arisaema triphyllum* (Jack in the pulpit), *Botrychium virginianum* (rattlesnake fern), *Lycopodium* (clubmoss) spp., *Maianthemum canadense* (Canada mayflower), *Maianthemum stellatum* (starry false lily of the valley), *Polygonatum pubescens* (hairy Solomon's seal), *Trillium grandiflorum* (snow trillium), and *Viola* (violet) spp.

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer saccharum* (sugar maple), *Fagus grandifolia* (American beech)
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Fagus grandifolia* (American beech)
Herb (field)	Forb	*Osmorhiza claytonii* (Clayton's sweetroot)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Aralia nudicaulis* (wild sarsaparilla), *Betula alleghaniensis* (yellow birch), *Fagus grandifolia* (American beech), *Maianthemum canadense* (Canada mayflower), *Mitchella repens* (partridgeberry), *Osmorhiza claytonii* (Clayton's sweetroot), *Polygonatum pubescens* (hairy Solomon's seal)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Vulnerable: *Panax quinquefolius* (American ginseng, collection pressure, G3G4);
Exotic/Invasive: *Arctium minus* (lesser burrdock, exotic, Medium/Insignificant), *Epipactis helleborine* (broadleaf helleborine, exotic, Medium/Low)

Global: Vulnerable: *Panax quinquefolius* (American ginseng, collection pressure, G3G4)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (3-Oct-1996).

CLASSIFICATION

Classification Confidence: 1 - Strong

Global Comments: *Fraxinus americana* (white ash) can occur in this type. Burning can deflect this type to *Quercus rubra - Acer saccharum - (Betula alleghaniensis)* Forest (CEGL002461) (D. Albert pers. comm. 1996, Michigan site at Colonial Point). Host and Pregitzer (1991) distinguish this community from *Acer saccharum - Betula alleghaniensis - (Tilia americana)* Forest (CEGL002457) based the abundance of *Lycopodium* (clubmoss) spp., *Maianthemum canadense* (Canada mayflower), and *Polygonatum pubescens* (hairy Solomon's seal) in this type. Some stands can have a scattered supercanopy of *Pinus strobus* (eastern white pine) (less than 25% cover), and although floristically such stands are very similar to this type, there may be some value in recognizing a separate type, *Acer saccharum - Pinus strobus / Acer pensylvanicum* Forest (CEGL005005). Further review of this issue is needed.

Global Similar Associations:

- *Acer saccharum - Betula alleghaniensis - (Tilia americana)* Forest (CEGL002457)
- *Acer saccharum - Betula alleghaniensis - Fagus grandifolia / Viburnum lantanoides* Forest (CEGL006252)
- *Acer saccharum - Fraxinus americana - Tilia americana / Acer spicatum / Caulophyllum thalictroides* Forest (CEGL005008)
- *Acer saccharum - Pinus strobus / Acer pensylvanicum* Forest (CEGL005005)
- *Acer saccharum - Tilia americana / Ostrya virginiana / Lonicera canadensis* Forest (CEGL002458)
- *Fagus grandifolia - Acer saccharum* Glaciated Midwest Forest (CEGL005013)
- *Quercus rubra - Acer saccharum - (Betula alleghaniensis)* Forest (CEGL002461)

Global Related Concepts:

- *Acer - Fagus / Adiantum* Habitat Type (Kotar and Burger 1989) F
- *Acer - Fagus / Viburnum* Habitat Type (Kotar and Burger 1989) F
- *Maianthemum* Group (Host and Pregitzer 1991) =
- Beech - Maple Hardwood Forest (Thompson 1984) =
- ELTP 40 - Sugar maple-beech-*Maianthemum* plant association (Cleland et al. 1994) F
- ELTP 42 - Sugar maple-*Maianthemum* plant association (Cleland et al. 1994) F
- ELTP 43 - Sugar maple-red oak-*Maianthemum* plant association (Cleland et al. 1994) F
- Mesic Northern Forest - Beech-Sugar Maple-Yellow Birch (Chapman et al. 1989) B

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ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Esch Road, Little Traverse Lake Road, Valley View Trail, Old Indian Trail, and Dunes Trail, at Shauger Hill, Alligator Hill (Forest Haven Road) and "Valley of the Giants" and on North Manitou Island and South Manitou Island (Florence Lake area).
Global Range: This northern hardwoods forest community type is found in the central Great Lakes area of the United States and Canada, ranging from Wisconsin and Michigan east to Ontario.
Nations: CA, US
States/Provinces: MI, ON, QC:S4?, WI:S2
USFS Ecoregions (1994/95): 212Ha:CCC, 212Hb:CCC, 212Hd:CCC, 212He:CCC, 212Hj:CCC, 212Hk:CCP, 212Hl:CCC, 212Hm:CCC, 212Hn:CCP, 212Ho:CCC, 212Hp:CCC, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Ht:CCC, 212Hu:CCP, 212Hv:CCC, 212Hw:CCC, 212Hx:CCC, 212Hy:CCC, 212Jc:CC?, 212Jj:CCC, 212Jl:CCC, 212Oa:CCC, 222Ja:CCC, 222Kc:CCC, 222Ke:CCC, 222Kf:CCC, 222Kg:CCC
Federal Lands: NPS (Sleeping Bear Dunes); USFS (Chequamegon-Nicolet?, Chequamegon?, Hiawatha, Huron, Huron-Manistee, Manistee, Nicolet?)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.1, SLBE.11, SLBE.23, SLBE.25, SLBE.28, SLBE.39, SLBE.88, SLBE.91, SLBE.95, SLBE.102.
Sleeping Bear Dunes National Lakeshore Sleeping Bear Dunes National Lakeshore Map Code: FBM
Local Description Authors: M.J. Russo
Global Description Authors: J. Drake, mod. D. Faber-Langendoen
References: Chapman et al. 1989, Cleland et al. 1994, Host and Pregitzer 1991, Kotar and Burger 1989, Midwestern Ecology Working Group n.d., Thompson 1984, WNHIP unpubl. data

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M159. Northern & Eastern Pine - Oak Forest, Woodland & Barrens

G160. Great Lakes Pine Barrens Group

Great Lakes Dune Pine Forest

***Pinus banksiana - Pinus resinosa - Pinus strobus* Dune Forest**
Jack Pine - Red Pine - Eastern White Pine Dune Forest
Identifier: CEGL002589

NVC CLASSIFICATION

Division	Eastern North American Cool Temperate Forest (1.C.2.Na)
Macrogroup	Northern & Eastern Pine - Oak Forest, Woodland & Barrens (M159)
Group	Great Lakes Pine Barrens Group (G160)
Association (Common name)	Great Lakes Dune Pine Forest
Ecological System(s):	Great Lakes Dune (CES201.026)
	Great Lakes Wooded Dune and Swale (CES201.726)

ELEMENT CONCEPT

Global Summary: This pine dune forest is found on dune systems on Lake Superior, Lake Michigan and Lake Huron in the United States and Canada. The canopy is more-or-less closed and is dominated by *Pinus banksiana* (jack pine), *Pinus resinosa* (red pine), and *Pinus strobus* (eastern white pine). This type has not been well-described, and further characterization is needed.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This pine dune forest was sampled at two locations in the park. The sites occur in narrow strips between coastal deciduous forest and dune vegetation and are flat with well-drained sandy loam and loamy sand soils. The unvegetated surface is dominated by leaf litter (50-55% cover) with some wood (1-3%), dead plant stems (2-5%) and mosses and lichens (40-44%). Evidence of disturbance includes dead standing and fallen trees and the presence of exotic plants.
Global Environment: Stands are found on dune systems along Lake Superior, Lake Michigan and Lake Huron.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The moderately sparse (30-40% cover) tree canopy, 10-20 m tall, is dominated by *Pinus strobus* (eastern white pine) and may include *Pinus banksiana* (jack pine) and *Pinus resinosa* (red pine). In addition, in these examples, there may be a very sparse (5%) emergent tree layer (20-35 m) and/or a sparse (20%) subcanopy (10-15 m) of canopy pines. *Pinus strobus* (eastern white pine) forms a sparse (10-30%) tall-shrub layer (2-5 m). The sparse (10-40%) short-shrub layer (0.5-2 m) may include *Juniperus communis* (common juniper), *Pinus banksiana* (jack pine), *Pinus strobus* (eastern white pine), *Prunus virginiana* (chokecherry), *Quercus rubra* (northern red oak), *Shepherdia canadensis* (russet buffaloberry), and *Tsuga canadensis* (eastern hemlock). *Arctostaphylos uva-ursi* (kinnikinnick), *Juniperus horizontalis* (creeping juniper), and *Vaccinium angustifolium* (lowbush blueberry) form a moderately dense (50-70%) dwarf-shrub layer. The sparse (10-30%) herbaceous layer may include *Calamagrostis canadensis* (bluejoint), *Campanula rotundifolia* (bluebell bellflower), *Carex pellita* (woolly sedge), *Chimaphila umbellata* (pipsissewa), *Comandra umbellata* (bastard toadflax), *Deschampsia flexuosa* (wavy hairgrass), *Dryopteris intermedia* (intermediate woodfern), *Epigaea repens* (trailing arbutus), *Fragaria virginiana* (Virginia strawberry), *Linnaea borealis* (twinflower), *Lithospermum caroliniense* (Carolina puccoon), *Maianthemum canadense* (Canada mayflower), *Maianthemum stellatum* (starry false lily of the valley), *Melampyrum lineare* (narrowleaf cowwheat), *Oryzopsis asperifolia* (roughleaf ricegrass), *Pteridium aquilinum* (western brackenfern), *Spiranthes tuberosa* (little ladies'-tresses) (state-imperiled), and *Trientalis borealis* (starflower). Nonvascular species (mosses and lichens) cover 40-50% of the ground surface.
Global Vegetation: The canopy is more-or-less closed and is dominated by *Pinus banksiana* (jack pine), *Pinus resinosa* (red pine), and *Pinus strobus* (eastern white pine). This type has not been well-described, and further characterization is needed.

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Pinus banksiana* (jack pine), *Pinus strobus* (eastern white pine)
Shrub/sapling (tall & short)	Needle-leaved shrub	*Pinus strobus* (eastern white pine)
Short shrub/sapling	Needle-leaved shrub	*Juniperus communis* (common juniper)
Herb (field)	Dwarf-shrub	*Juniperus horizontalis* (creeping juniper), *Vaccinium angustifolium* (lowbush blueberry)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Arctostaphylos uva-ursi* (kinnikinnick), *Juniperus communis* (common juniper), *Juniperus horizontalis* (creeping juniper), *Oryzopsis asperifolia* (roughleaf ricegrass), *Pinus banksiana* (jack pine), *Pinus resinosa* (red pine), *Pinus strobus* (eastern white pine), *Vaccinium angustifolium* (lowbush blueberry)

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OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Vulnerable: *Spiranthes tuberosa* (little ladies'-tresses, state-imperiled, G5);
Exotic/Invasive: *Berberis vulgaris* (common barberry, exotic, Medium/Low), *Cirsium arvense* (Canada thistle, exotic, High/Medium)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3Q (24-Oct-2002). This type is found within the coastal areas of Lake Superior, Lake Michigan and Lake Huron where it is a component of a complex dune-and-swale system found along the lakeplains. It is primarily restricted to drier, sandy soils on dune tops or ridges. It is listed for the United States, but currently not attributed to Canada. More information on the status of this type is needed.

CLASSIFICATION

Classification Confidence: 3 - Weak
Global Comments: Type is not described in Ontario by Lee et al. (1998). Its extent in the United States may be limited, and a review of its concept is needed. Perhaps this type can be combined with Great Lakes Pine Barrens, *Pinus banksiana - (Pinus resinosa) - Pinus strobus / Juniperus horizontalis* Wooded Herbaceous Vegetation (CEGL005125), or can be dissolved into the respective *Pinus banksiana* (jack pine), *Pinus resinosa* (red pine) or *Pinus strobus* (eastern white pine) inland forests on sand. Type (whether as forest or barrens) has been eliminated in Illinois.
Global Similar Associations:

- *Pinus banksiana - (Pinus resinosa) - Pinus strobus / Juniperus horizontalis* Wooded Herbaceous Vegetation (CEGL005125)--This is the open Great Lakes pine barrens type.
- *Pinus resinosa / Vaccinium* spp. Forest (CEGL002443)
- *Pinus strobus / Vaccinium* spp. Forest (CEGL002444)

Global Related Concepts:

- Great Lakes Barren (Chapman et al. 1989) B

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Peterson Road and at Good Harbor Bay but is extensive along the coast of Lake Michigan, especially in the Good Harbor Bay and Platte Bay areas.
Global Range: This pine dune forest type is found on dune systems on Lake Superior, Lake Michigan and Lake Huron in the United States and possibly in Canada, ranging from Wisconsin and Michigan to Ontario, and, at least historically, in Indiana and Illinois.
Nations: CA, US
States/Provinces: IL, IN, MI, ON, QC:S3?, WI
USFS Ecoregions (1994/95): 212Ha:CC?, 212Hb:CC?, 212He:CCC, 212Hh:CC?, 212Hi:CCC, 212Hj:CCC, 212Hk:CC?, 212Hl:CCC, 212Ho:CCC, 212Hr:CCP, 212Hw:CCC, 212Hx:CCC, 212Ia:CCC, 212Ja:CC?, 212Jn:CC?, 212Jr:CCC, 212Oa:CCC, 222Jj:CCC
Federal Lands: NPS (Apostle Islands, Indiana Dunes, Pictured Rocks, Sleeping Bear Dunes); USFS (Hiawatha, Huron-Manistee, Huron?, Manistee)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.6, SLBE.49.
Sleeping Bear Dunes National Lakeshore Map Code: FPD
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Bakowsky and Lee 1996, Chapman et al. 1989, Farrand and Bell 1982, Lee et al. 1998, Midwestern Ecology Working Group n.d.

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G025. White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group

Jack Pine - Northern Pin Oak Forest

***Pinus banksiana - (Pinus resinosa) - Quercus ellipsoidalis / Carex pensylvanica* Forest**
Jack Pine - (Red Pine) - Northern Pin Oak / Pennsylvania Sedge Forest
Identifier: CEGL002478

NVC CLASSIFICATION

Division	Eastern North American Cool Temperate Forest (1.C.2.Na)
Macrogroup	Northern & Eastern Pine - Oak Forest, Woodland & Barrens (M159)
Group	White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group (G025)
Association (Common name)	Jack Pine - Northern Pin Oak Forest
Ecological System(s):	Laurentian Pine-Oak Barrens (CES201.718)

ELEMENT CONCEPT

Global Summary: This jack pine - oak forest community type is found near the western Great Lakes of the United States and Canada on well-drained, sandy, infertile soils. Sites are typically relatively flat and occur on outwash plains or glaciolacustrine beds. The overstory of this forest community has a moderately closed to closed canopy. Tree density can be very high (up to several hundred trees/ha). The dominant canopy species are *Pinus banksiana* (jack pine) and *Quercus ellipsoidalis* (northern pin oak). In some stands these two species constitute nearly the entire canopy. Where other trees are present, they typically include *Acer rubrum* (red maple), *Pinus resinosa* (red pine), and *Populus tremuloides* (quaking aspen). The shrub layer is sparse to well-defined. *Vaccinium angustifolium* (lowbush blueberry) is very common, but *Corylus cornuta* (beaked hazelnut), *Corylus americana* (American hazelnut), *Rosa* (rose) spp., and *Rubus* (blackberry) spp. are other common constituents. *Gaylussacia baccata* (black huckleberry) is common in central Michigan and Wisconsin. The herbaceous layer contains species such as *Carex pensylvanica* (Pennsylvania sedge), *Fragaria virginiana* (Virginia strawberry), *Lysimachia quadrifolia* (whorled yellow loosestrife), *Maianthemum canadense* (Canada mayflower), *Maianthemum racemosum* (feathery false lily of the valley), and *Pteridium aquilinum* (western brackenfern).

ENVIRONMENTAL DESCRIPTION

Global Environment: This community is found on well-drained, sandy, infertile soils (Curtis 1959). Sites are typically relatively flat and occur on outwash plains or glaciolacustrine beds (MNNHP 1993).

VEGETATION DESCRIPTION

Global Vegetation: *Vaccinium angustifolium* (lowbush blueberry) is very common, but *Corylus americana* (American hazelnut), *Corylus cornuta* (beaked hazelnut), *Rosa* (rose) spp., and *Rubus* (blackberry) spp. are other common constituents. *Gaylussacia baccata* (black huckleberry) is common in central Michigan and Wisconsin. The herbaceous layer contains species such as *Carex pensylvanica* (Pennsylvania sedge), *Fragaria virginiana* (Virginia strawberry), *Lysimachia quadrifolia* (whorled yellow loosestrife), *Maianthemum canadense* (Canada mayflower), *Maianthemum racemosum* (feathery false lily of the valley), and *Pteridium aquilinum* (western brackenfern) (Curtis 1959, MNNHP 1993).

CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (3-Oct-1996).

CLASSIFICATION

Classification Confidence: 2 - Moderate
Global Comments: *Pinus strobus* (eastern white pine), *Quercus rubra* (northern red oak), *Quercus macrocarpa* (bur oak) and *Quercus velutina* (black oak) may also occur in this type. The distinction between this type and *Pinus banksiana / (Quercus rubra, Quercus ellipsoidalis)* Forest (CEGL002440) is that the latter is primarily found on bedrock, with oaks occurring primarily as grubs and only rarely are in the canopy. This type also overlaps with *Pinus banksiana / Vaccinium* spp. / *Pleurozium schreberi* (Schreber's big red stem moss) Forest (CEGL002441), especially in Wisconsin, where timber management can cause a lot of variation in the proportion of oak and pine (E. Epstein pers. comm. 2000).
Global Similar Associations:
- *Pinus banksiana / (Quercus rubra, Quercus ellipsoidalis)* Forest (CEGL002440)--This is a dry, pure evergreen jack pine type with some oak in the understory, found most typically on bedrock.
- *Pinus banksiana / Vaccinium* spp. / *Pleurozium schreberi* Forest (CEGL002441)--This is the pure evergreen jack pine type.

Global Related Concepts:
- Dry Northern Forest - Red Pine-Jack Pine (Oak) (Chapman et al. 1989) B

ELEMENT DISTRIBUTION

Global Range: This community is found in northern Minnesota, northern and central Wisconsin, northern Michigan, and Ontario.
Nations: CA, US
States/Provinces: MI, MN, ON, WI
USFS Ecoregions (1994/95): 212Hb:CCP, 212He:CCP, 212Hi:CCP, 212Hm:CCP, 212Hp:CCC, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hu:CCP, 212Hv:CCP, 212Hw:CCP, 212Hy:CCP, 212Ia:CCC, 212Ja:CPP, 212Jb:CP?, 212Jc:CPP,

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212Jj:CPP, 212Jl:CPP, 212Jm:CPP, 212Jn:CPP, 212Jo:CPP, 212Jr:CPP, 212Ka:CPP, 212Na:CCP, 212Nb:CCP, 212Nc:CCC, 212Oa:CCC,222Ka:CCC

Federal Lands: NPS (Apostle Islands, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: This association was not sampled with plots at Sleeping Bear Dunes NL.
Sleeping Bear Dunes National Lakeshore Map Code: FJO
Local Description Authors: NA
Global Description Authors: J. Drake
References: Chapman et al. 1989, Curtis 1959, MNNHP 1993, Midwestern Ecology Working Group n.d., WNHIP unpubl. data

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Red Pine - Aspen - Birch Forest

***Pinus resinosa - Populus tremuloides / Diervilla lonicera - Vaccinium* spp. Forest**
Red Pine - Quaking Aspen / Northern Bush-honeysuckle - Blueberry species Forest
Identifier: CEGL002520

NVC CLASSIFICATION

Division	Eastern North American Cool Temperate Forest (1.C.2.Na)
Macrogroup	Northern & Eastern Pine - Oak Forest, Woodland & Barrens (M159)
Group	White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group (G025)
Association (Common name)	Red Pine - Aspen - Birch Forest
Ecological System(s):	Laurentian-Acadian Northern Pine-(Oak) Forest (CES201.719)

ELEMENT CONCEPT

Global Summary: This red pine - hardwood mixed forest is found in the boreal regions of the midwestern United States and in central and possibly eastern Canada. Stands are found on well-drained upland sites on a variety of landforms. Soils are coarse sandy and shallow to deep. Stands contain a mix of deciduous and evergreen trees, comprising mainly *Pinus resinosa* (red pine) as the conifer, with some *Pinus banksiana* (jack pine), *Pinus strobus* (eastern white pine), and *Abies balsamea* (balsam fir). Less frequent associates include *Picea glauca* (white spruce) and *Picea mariana* (black spruce). Hardwoods include *Betula papyrifera* (paper birch), *Populus grandidentata* (bigtooth aspen) and *Populus tremuloides* (quaking aspen). The shrub and herb layers vary from dense to open. Tall and dwarf-shrubs include *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Amelanchier* (serviceberry) spp., *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Linnaea borealis* (twinflower), *Lonicera canadensis* (American fly honeysuckle), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry). Herbs include *Eurybia macrophylla* (bigleaf aster), *Aralia nudicaulis* (wild sarsaparilla), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), and *Maianthemum canadense* (Canada mayflower). Large patches of feathermoss can develop on the forest floor. Moss species include *Dicranum polysetum* (dicranum moss) and *Pleurozium schreberi* (Schreber's big red stem moss).

ENVIRONMENTAL DESCRIPTION

Global Environment: Stands are found on well-drained upland sites on a variety of landforms. Soils are coarse sandy, and shallow to deep (Sims et al. 1989, McCarthy et al. 1994).

VEGETATION DESCRIPTION

Global Vegetation: Stands contain a mix of deciduous and evergreen trees, comprising mainly *Pinus resinosa* (red pine) as the conifer, with some *Pinus banksiana* (jack pine), *Pinus strobus* (eastern white pine), and *Abies balsamea* (balsam fir). Less frequent associates include *Picea glauca* (white spruce) and *Picea mariana* (black spruce). Hardwoods include *Betula papyrifera* (paper birch), *Populus grandidentata* (bigtooth aspen) and *Populus tremuloides* (quaking aspen). The shrub and herb layer varies from dense to open. Tall and dwarf-shrubs include *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Amelanchier* (serviceberry) spp., *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Linnaea borealis* (twinflower), *Lonicera canadensis* (American fly honeysuckle), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry). Herbs include *Eurybia macrophylla* (bigleaf aster), *Aralia nudicaulis* (wild sarsaparilla), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), and *Maianthemum canadense* (Canada mayflower). Large patches of feathermoss can develop on the forest floor. Moss species include *Dicranum polysetum* (dicranum moss) and *Pleurozium schreberi* (Schreber's big red stem moss) (Sims et al. 1989, McCarthy et al. 1994).

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (3-Oct-1996).

CLASSIFICATION

Classification Confidence: 2 - Moderate
Global Comments: This type overlaps floristically with *Pinus resinosa / Vaccinium* spp. Forest (CEGL002443), the pure evergreen red pine forest, but is somewhat more diverse in the shrub and herb layers.
Global Similar Associations:
- *Pinus resinosa / Vaccinium* spp. Forest (CEGL002443)

Global Related Concepts:
- Red Pine Mixedwood (V13) (Sims et al. 1989) =
- Red Pine Mixedwood (V5) (McCarthy et al. 1994) =

ELEMENT DISTRIBUTION

Global Range: This red pine-hardwood mixed forest community type is found in the boreal regions of the midwestern United States and in central and possibly eastern Canada, ranging from Minnesota north and east to Manitoba, Ontario and possibly elsewhere in eastern Canada.
Nations: CA, US
States/Provinces: MB?, MI, MN, ON, QC, WI

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USFS Ecoregions (1994/95): 212Hi:CCC, 212Ia:CCC, 212Ja:CCC, 212Kb:CCC, 212La:CCP, 212Lb:CCC, 212Ld:CCC, 212:Oa:CCC

Federal Lands: NPS (Apostle Islands, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Superior?)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: This association was not sampled with plots at Sleeping Bear Dunes NL.

Sleeping Bear Dunes National Lakeshore Map Code: FRA

Local Description Authors: NA

Global Description Authors: D. Faber-Langendoen

References: Greenall 1996, McCarthy et al. 1994, Midwestern Ecology Working Group n.d., Sims et al. 1989

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Red Pine / Blueberry Dry Forest

***Pinus resinosa / Vaccinium* spp. Forest**
Red Pine / Blueberry species Forest
Identifier: CEGL002443

NVC CLASSIFICATION

Division	Eastern North American Cool Temperate Forest (1.C.2.Na)
Macrogroup	Northern & Eastern Pine - Oak Forest, Woodland & Barrens (M159)
Group	White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group (G025)
Association (Common name)	Red Pine / Blueberry Dry Forest
Ecological System(s):	Laurentian-Acadian Northern Pine-(Oak) Forest (CES201.719)

ELEMENT CONCEPT

Global Summary: This upland red pine community is found in the boreal regions of the midwestern United States and in central and possibly eastern Canada. This community occurs on Precambrian bedrock, overlaid with medium deep, coarse sand or coarse loam soils. Moisture varies from dry to dry-mesic, and stands are on mid to upper gentle slopes. Stands contain a pine overstory and a poorly developed understory. *Pinus resinosa* (red pine) is the dominant overstory species (generally >80% cover). *Pinus strobus* (eastern white pine) can be prominent in the canopy and is often numerous in the sapling and seedling classes. Other species include *Abies balsamea* (balsam fir), *Pinus banksiana* (jack pine), *Picea mariana* (black spruce), *Picea glauca* (white spruce), and *Populus tremuloides* (quaking aspen). Northern hardwoods, such as *Acer rubrum* (red maple) and *Betula papyrifera* (paper birch), sometimes form a subcanopy. The understory ranges from moderately herb- and shrub-rich to extremely poor. In the tall-shrub strata, the important species are *Amelanchier* (serviceberry) spp. and *Corylus cornuta* (beaked hazelnut). The short-shrub layer includes *Linnaea borealis* (twinflower), *Gaultheria procumbens* (eastern teaberry), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry), particularly where gaps in the canopy occur. The herb layer is very poorly represented in most parts of this community's range and includes *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Cornus canadensis* (bunchberry dogwood), *Maianthemum canadense* (Canada mayflower), *Pteridium aquilinum* (western brackenfern), and *Trientalis borealis* (starflower). Mosses are abundant, especially *Dicranum* (dicranum moss) spp. (including *Dicranum polysetum* (dicranum moss)) and *Pleurozium schreberi* (Schreber's big red stem moss). Diagnostic features include the dominance of *Pinus resinosa* (red pine) and the ericaceous understory.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This red pine forest was sampled at three locations in the park. Sites are generally flat with some rolling microtopography and have well-drained sandy loam and loamy sand soils. The unvegetated surface is dominated by leaf litter (87-95% cover) with some wood (2-5%), dead plant stems (3%) and mosses (0-5%). Evidence of disturbance includes dead standing jack pine and numerous stumps.
Global Environment: This community occurs on Precambrian bedrock, overlaid with medium deep (>60 cm), coarse sand or coarse loam soils. Moisture varies from dry to dry-mesic, and stands are on mid to upper gentle slopes. The climate is highly variable, with temperature extremes between -46 and 38 degrees C, and with anywhere from 58-91 cm of precipitation.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The moderate (50-60% cover) tree canopy, 20-35 m tall, is dominated by *Pinus resinosa* (red pine) and may include lesser amounts of *Acer rubrum* (red maple), *Pinus banksiana* (jack pine), and *Pinus strobus* (eastern white pine), as does the very sparse (5-20%) subcanopy (10-15 m). The shrub layers are negligible. *Vaccinium angustifolium* (lowbush blueberry) and *Vaccinium myrtilloides* (velvetleaf huckleberry) form a sparse to moderate (20-40%) dwarf-shrub layer which may also include *Gaylussacia baccata* (black huckleberry). The moderate to moderately dense (50-70%) herbaceous layer is dominated by *Pteridium aquilinum* (western brackenfern) and may include *Cypripedium acaule* (moccasin flower), *Epigaea repens* (trailing arbutus), *Gaultheria procumbens* (eastern teaberry), *Maianthemum canadense* (Canada mayflower), *Melampyrum lineare* (narrowleaf cowwheat), *Trientalis borealis* (starflower), and others, including many pine and oak seedlings. Nonvascular species (mosses) cover 5% or less of the ground surface.
Global Vegetation: This community is characterized by a pine overstory and a poorly developed understory. *Pinus resinosa* (red pine) is present in the canopy at higher cover and basal area than other conifers (typically 80% or more). *Pinus strobus* (eastern white pine) can be common in the canopy. Mesic sites tend to include not only *Pinus resinosa* (red pine) in the canopy, but also *Picea mariana* (black spruce), *Picea glauca* (white spruce), and *Abies balsamea* (balsam fir), whereas on dry sites, *Pinus banksiana* (jack pine) is found (MNNHP 1993). Beneath the canopy, northern hardwoods, such as *Acer rubrum* (red maple) and *Betula papyrifera* (paper birch), sometimes form a subcanopy. The understory ranges from moderately herb- and shrub-rich to extremely poor. In the tall shrub class, the important species are *Amelanchier* (serviceberry) spp. and *Corylus cornuta* (beaked hazelnut). The short-shrub layer includes *Gaultheria procumbens* (eastern teaberry), *Linnaea borealis* (twinflower), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry), particularly where gaps in the canopy occur (Ohmann and Ream 1971). The herb layer is very poorly represented in most parts of this community's range and includes *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Cornus canadensis* (bunchberry dogwood), *Maianthemum canadense* (Canada mayflower), *Pteridium aquilinum* (western brackenfern), and *Trientalis borealis* (starflower). Mosses can have very high cover and typically include *Dicranum* (dicranum moss) spp. (including *Dicranum polysetum* (dicranum moss)) and *Pleurozium schreberi* (Schreber's big red stem

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moss). The average coverage of feathermoss is greater in the northwest region of Ontario than in the north-central region (Sims et al. 1989).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus resinosa* (red pine)
Herb (field)	Dwarf-shrub	*Vaccinium angustifolium* (lowbush blueberry), *Vaccinium myrtilloides* (velvetleaf huckleberry)
Herb (field)	Fern or fern ally	*Pteridium aquilinum* (western brackenfern)

Global

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus resinosa* (red pine)
Tall shrub/sapling	Broad-leaved evergreen tree	*Corylus cornuta* (beaked hazelnut)
Short shrub/sapling	Broad-leaved deciduous shrub	*Vaccinium angustifolium* (lowbush blueberry), *Vaccinium myrtilloides* (velvetleaf huckleberry)
Nonvascular	Moss	*Pleurozium schreberi* (Schreber's big red stem moss)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Pinus resinosa* (red pine), *Pteridium aquilinum* (western brackenfern), *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium myrtilloides* (velvetleaf huckleberry)
Global: *Corylus cornuta* (beaked hazelnut), *Pinus resinosa* (red pine), *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium myrtilloides* (velvetleaf huckleberry)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (6-Feb-2007). There are probably over 100 occurrences of this community rangewide. Currently there are 77 occurrences documented from Michigan (where it is ranked S3), Minnesota (S3), and Wisconsin (S3); it is also reported from Manitoba (S3) and Ontario (S?). There are probably over 10,000 acres of this community rangewide. Currently 5545 acres have been documented from 45 occurrences in Michigan, Minnesota, and Wisconsin. Many sites have been degraded by logging, but there are also many mature to old-growth stands remaining.

CLASSIFICATION

Classification Confidence: 1 - Strong
Global Comments: Stands are dominated by *Pinus resinosa* (red pine), with at least 60% cover, and typically 80% or more. Stands can intergrade with white pine, and these mixed stands are placed with the white pine types, either White Pine-Mountain Maple Mesic Forest, *Pinus strobus / Acer spicatum - Corylus cornuta* Forest (CEGL002445), or White Pine/Blueberry Dry-mesic Forest, *Pinus strobus / Vaccinium* spp. Forest (CEGL002444). Red pine stands in the central Great Lakes region, often on sandy outwash, are treated with more boreal stands as one type, since the ericaceous component is similar. It remains to be seen whether the central stands lack enough of the more common boreal elements of the northern stands to warrant a separate type.

A survey of vegetation of the dunes of Lake Michigan in Manistee National Forest in Michigan (Hazlett 1986) found a community very similar to *Pinus resinosa / Vaccinium* spp. Forest. This pine forest would appear to belong with the Great Lakes Dune Pine Forest, *Pinus banksiana - Pinus resinosa - Pinus strobus* Dune Forest (CEGL002589). The described community was closely associated with bogs within the lake dunes. The forest canopy was dominated by *Pinus resinosa* (red pine) (75-100% cover), although on the drier ridges inclusions of *Quercus velutina* (black oak) and *Populus grandidentata* (bigtooth aspen) were common. Other trees that were found in the canopy included *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Quercus alba* (white oak), and *Quercus rubra* (northern red oak). In the understory, species that were found in this community subtype, but not in the main community type, included *Gaylussacia baccata* (black huckleberry), *Hamamelis virginiana* (American witch-hazel), and *Viburnum nudum* var. *cassinoides* (withe-rod). Many species of herbs were present, but no feathermosses were listed.
Global Similar Associations:
- *Pinus banksiana - (Pinus resinosa) / Corylus cornuta* Forest (CEGL002442)
- *Pinus banksiana - (Quercus ellipsoidalis) / Schizachyrium scoparium* - Prairie Forbs Wooded Herbaceous Vegetation (CEGL002490)
- *Pinus banksiana - Pinus resinosa - (Quercus ellipsoidalis) / Carex pensylvanica* Wooded Herbaceous Vegetation (CEGL005124)
- *Pinus banksiana - Pinus resinosa - Pinus strobus* Dune Forest (CEGL002589)
- *Pinus resinosa - Populus tremuloides / Diervilla lonicera - Vaccinium* spp. Forest (CEGL002520)--is dominated by red pine and aspen and/or birch.
- *Pinus strobus - Populus tremuloides / Corylus cornuta* Forest (CEGL002479)--is dominated by white pine and aspen.
- *Pinus strobus / Acer spicatum - Corylus cornuta* Forest (CEGL002445)
- *Pinus strobus / Vaccinium* spp. Forest (CEGL002444)--pure white pine type on drier sites with blueberry/feathermoss understory that resembles red pine stands.

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Global Related Concepts:

- Dry Northern Forest - Red Pine-Jack Pine (Oak) (Chapman et al. 1989) B
- Red Pine (Ohmann and Ream 1971) =
- Red Pine Conifer (V27) (Sims et al. 1989) ?
- Red Pine-White Pine-Jack Pine-Blueberry-Feathermoss (V30) (Chambers et al. 1997) F
- Red Pine-White Pine-Jack Pine-Largetooth Aspen-White Pine Shrub-Wintergreen (V31) (Chambers et al. 1997) F

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Boekaloo Road, Deer Lake Road and Otter Creek Trail (west).

Global Range: This upland red pine community type is found in the boreal regions of the midwestern United States and in central and possibly eastern Canada, ranging from Minnesota and southwestern Manitoba east to Michigan, Ontario, and possibly further east.

Nations: CA, US

States/Provinces: MB:S1, MI, MN:S3, ON, QC:S3?, WI:S3

USFS Ecoregions (1994/95): 212Ha:CCC, 212Hb:CCP, 212He:CC?, 212Hh:CCC, 212Hi:CCP, 212Hj:CCC, 212Hk:CC?, 212Hl:CCC, 212Hm:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCC, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hu:CCP, 212Hv:CCP, 212Hw:CCC, 212Hx:CCP, 212Hy:CCP, 212Ia:CCC, 212Ja:CCC, 212Jb:CCP, 212Jc:CCC, 212Jf:CCP, 212Jj:CCP, 212Jl:CCC, 212Jm:CCC, 212Jn:CCP, 212Jo:CC?, 212Ka:CCC, 212Kb:CCC, 212La:CCC, 212Lb:CCP, 212Lc:CCC, 212Mb:CCC, 212Na:CCC, 212Nb:CCC, 212Nc:CCC, 212:Oa:CCC, 222Mc:CCC

Federal Lands: NPS (Apostle Islands, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Hiawatha, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa, Superior)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.5, SLBE.32, SLBE.55.

Sleeping Bear Dunes National Lakeshore Map Code: FRP

Local Description Authors: M.J. Russo

Global Description Authors: A. Szostak, mod. D. Faber-Langendoen 04-00

References: Ahlgren 1974, Chambers et al. 1997, Chapman et al. 1989, Farrand and Bell 1982, Frelich 1992, Greenall 1996, Grigal and Ohmann 1975, Hazlett 1986, Heinselman 1973, MNNHP 1993, Midwestern Ecology Working Group n.d., Ohmann and Ream 1971, Sims et al. 1989, WNHIP unpubl. data

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White Pine - Red Oak Forest

***Pinus strobus* - *(Pinus resinosa)* - *Quercus rubra* Forest**
Eastern White Pine - (Red Pine) - Northern Red Oak Forest
Identifier: CEGL002480

NVC CLASSIFICATION

Division	Eastern North American Cool Temperate Forest (1.C.2.Na)
Macrogroup	Northern & Eastern Pine - Oak Forest, Woodland & Barrens (M159)
Group	White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group (G025)
Association (Common name)	White Pine - Red Oak Forest
Ecological System(s):	Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563)
	Laurentian-Acadian Northern Pine-(Oak) Forest (CES201.719)

ELEMENT CONCEPT

Global Summary: This white pine - oak forest occurs in the central Great Lakes region of the United States and Canada, where it occurs on dry to dry-mesic sites with well-drained sandy loams or coarser soils, typically on morainal slopes. *Pinus strobus* (eastern white pine) is the dominant component of the overstory, often forming a supercanopy above the hardwood canopy. *Quercus rubra* (northern red oak) is an important canopy species, along with *Acer saccharum* (sugar maple), and *Quercus alba* (white oak) in central Minnesota, and, farther eastward, *Fraxinus americana* (white ash), *Quercus velutina* (black oak), and occasional *Fagus grandifolia* (American beech). Northern stands may contain *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Pinus resinosa* (red pine), *Pinus strobus* (eastern white pine), *Populus grandidentata* (bigtooth aspen), and *Populus tremuloides* (quaking aspen), along with *Abies balsamea* (balsam fir) in the understory. The shrub and vine layer in the southern part of the range contains *Cornus foemina* (stiff dogwood), *Corylus americana* (American hazelnut), *Parthenocissus quinquefolia* (Virginia creeper), and *Vaccinium angustifolium* (lowbush blueberry), and, farther north, *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Gaultheria procumbens* (eastern teaberry), *Vaccinium angustifolium* (lowbush blueberry), and *Viburnum acerifolium* (mapleleaf viburnum). Typical herbs in the southern part of the range include *Amphicarpaea bracteata* (American hogpeanut), *Aralia nudicaulis* (wild sarsaparilla), *Carex pensylvanica* (Pennsylvania sedge), and *Geranium maculatum* (spotted geranium); farther north, they include *Eurybia macrophylla* (bigleaf aster), *Maianthemum canadense* (Canada mayflower), *Oryzopsis asperifolia* (roughleaf ricegrass), *Polygala paucifolia* (gaywings), *Polygonatum pubescens* (hairy Solomon's seal), *Pteridium aquilinum* (western brackenfern), and *Trientalis borealis* (starflower). Mosses include *Ptilidium pulcherrimum*.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This white pine - northern red oak forest was sampled at four locations in the park. Sites are located on old dune swales and ridges with some rolling microtopography and variable aspect. Soils are well-drained sandy loam and loamy sand. The unvegetated surface is dominated by leaf litter (90-95% cover) with some wood (2-4%), dead plant stems (2-4%) and mosses (0-3%). Evidence of disturbance includes dead standing and fallen trees and the presence of exotic plants.

Global Environment: Sites are found on dry-mesic to mesic sites with well-drained sandy loams or coarser soils, typically on morainal slopes and ridges.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The moderately dense (60-70% cover) tree canopy, 15-35 m tall, is dominated by *Quercus rubra* (northern red oak) and may include *Acer rubrum* (red maple), *Pinus resinosa* (red pine), *Pinus strobus* (eastern white pine), *Populus grandidentata* (bigtooth aspen), and *Quercus alba* (white oak). *Quercus velutina* (black oak) is also likely present, though distinguishing between *Q. rubra* and *Q. velutina* can be difficult. The sparse to moderate (30-60%) subcanopy (10-15 m) is made up of canopy species, as is the very sparse (5-30%) tall-shrub layer (2-5 m) and very sparse (5%) short-shrub layer (0.5-2 m). *Gaylussacia baccata* (black huckleberry), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry) form a sparse to moderate (20-50%) dwarf-shrub layer. The sparse to moderate (20-50%) herbaceous layer is dominated by *Pteridium aquilinum* (western brackenfern) and may include *Deschampsia flexuosa* (wavy hairgrass), *Gaultheria procumbens* (eastern teaberry), *Maianthemum canadense* (Canada mayflower), *Melampyrum lineare* (narrowleaf cowwheat), and *Trientalis borealis* (starflower) along with many tree seedlings.

Global Vegetation: *Pinus strobus* (eastern white pine) is the dominant component of the overstory, often forming a supercanopy above the hardwood canopy. *Quercus rubra* (northern red oak) is an important canopy species, along with *Acer saccharum* (sugar maple) and *Quercus alba* (white oak) in central Minnesota, and, farther eastward, *Fraxinus americana* (white ash), *Quercus velutina* (black oak), and occasional *Fagus grandifolia* (American beech). Northern stands may contain *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Pinus resinosa* (red pine), *Pinus strobus* (eastern white pine), *Populus grandidentata* (bigtooth aspen), and *Populus tremuloides* (quaking aspen), along with *Abies balsamea* (balsam fir) in the understory. The shrub and vine layer in the southern part of the range contains *Cornus foemina* (stiff dogwood), *Corylus americana* (American hazelnut), *Parthenocissus quinquefolia* (Virginia creeper), and *Vaccinium angustifolium* (lowbush blueberry), and, farther north, *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Gaultheria procumbens* (eastern teaberry), *Vaccinium angustifolium* (lowbush blueberry), and *Viburnum acerifolium* (mapleleaf viburnum). Typical herbs in the southern part of the range include *Amphicarpaea bracteata* (American hogpeanut), *Aralia nudicaulis* (wild sarsaparilla), *Carex pensylvanica* (Pennsylvania sedge), and

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Geranium maculatum (spotted geranium); farther north, they include *Eurybia macrophylla* (bigleaf aster), *Maianthemum canadense* (Canada mayflower), *Oryzopsis asperifolia* (roughleaf ricegrass), *Polygala paucifolia* (gaywings), *Polygonatum pubescens* (hairy Solomon's seal), *Pteridium aquilinum* (western brackenfern), and *Trientalis borealis* (starflower). Mosses include *Ptilidium pulcherrimum*, among others (Eyre 1980, MNNHP 1993, Chambers et al. 1997).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Quercus rubra* (northern red oak)
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
Shrub/sapling (tall & short)	Needle-leaved shrub	*Pinus strobus* (eastern white pine)
Herb (field)	Dwarf-shrub	*Gaylussacia baccata* (black huckleberry), *Vaccinium angustifolium* (lowbush blueberry)
Herb (field)	Fern or fern ally	*Pteridium aquilinum* (western brackenfern)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Acer rubrum* (red maple), *Deschampsia flexuosa* (wavy hairgrass), *Gaylussacia baccata* (black huckleberry), *Pinus strobus* (eastern white pine), *Pteridium aquilinum* (western brackenfern), *Quercus rubra* (northern red oak), *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium myrtilloides* (velvetleaf huckleberry)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Poa compressa* (Canada bluegrass, exotic, High/Low)
Global: Vulnerable: *Panax quinquefolius* (American ginseng, collection pressure, G3G4)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (13-Nov-2006). This association occurs in the Great Lake states region of the U.S. and in Ontario, Canada. More than 50 EOs are known from the U.S. portion of the range, and more are expected in Ontario. Currently the majority of reported EOs are ranked either A or B. Further review is needed of current assignment of EORANK to EOs of this type. Many stands are relatively large in size and total acreage well exceeds 10,000 acres. Both oaks and white pine have been extensively logged and cleared for agriculture throughout the range of this type. Although a number of EOs are in protected areas, little is known about the degree to which management is focused on the maintenance of this association. The type is dependent on fire disturbances and relatively dry substrates, and is dominated by oaks and white pine that are fairly resilient to both natural and anthropogenic disturbances.

CLASSIFICATION

Classification Confidence: 2 - Moderate
Global Comments: Distinction between this type and *Pinus strobus - Quercus alba / (Corylus americana, Gaylussacia baccata)* Forest (CEGL002481), which is found on sands, needs clarification. Compare also with *Pinus strobus - Quercus (rubra, velutina) - Fagus grandifolia* Forest (CEGL006293) in the East. Type may have a boreal variant (see Voyageurs NP and descriptions from central Ontario (Chambers et al. 1997). If Minnesota White Pine-Hardwood Forest (especially north-central subtype) is primarily a sandplain type, all of it should be placed with CEGL002481. In Wisconsin, this type grades into the pure evergreen white pine type, *Pinus strobus / Acer spicatum - Corylus cornuta* Forest (CEGL002445).
Global Similar Associations:
- *Pinus strobus - Populus tremuloides / Corylus cornuta* Forest (CEGL002479)
- *Pinus strobus - Quercus (rubra, velutina) - Fagus grandifolia* Forest (CEGL006293)--Eastern region version of same type?
- *Pinus strobus - Quercus alba / (Corylus americana, Gaylussacia baccata)* Forest (CEGL002481)--This is a sandplain type in the sandplains of central MN, WI, and MI.
- *Pinus strobus / Acer spicatum - Corylus cornuta* Forest (CEGL002445)
- *Quercus rubra - Quercus alba - (Quercus velutina, Acer rubrum) / Viburnum acerifolium* Forest (CEGL002462)

Global Related Concepts:
- Dry-Mesic Northern Forest - White Pine (Red Pine)-Oak (Chapman et al. 1989) =
- White Pine - Northern Red Oak - Red Maple: 20 (Eyre 1980) =
- White Pine-White Birch-Red Oak-Largetooth Aspen-Bracken Fern (Chambers et al. 1997) =

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Peterson Road, Old Indian Trail (Green Arrow Loop) and Good Harbor Bay Trail (west) and at Bass Lake.
Global Range: This white pine - oak forest community occurs in the central Great Lakes region of the United States and Canada, where it occurs on dry to dry-mesic sites. Stands range from Minnesota east to Michigan and Ontario. Range extent is about 300,000 square km.
Nations: CA, US
States/Provinces: MI:S3, MN, ON, QC:S4?, WI:S3
USFS Ecoregions (1994/95): 212Eb:CCC, 212Hb:CCP, 212He:CCC, 212Hi:CCC, 212Hj:CCC, 212Hl:CCC, 212Hm:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Ht:CCP, 212Hu:CCP, 212Hv:CCC, 212Hw:CCC, 212Ja:CCP, 212Jb:CCC, 212Jc:CCP, 212Jf:CCP, 212Jj:CCP, 212Jl:CCP, 212Jm:CCC, 212Jn:CCP, 212Jr:CCC, 212Ka:CCP, 212Kb:CCC, 212Mb:CPP,

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212Na:CPP, 212Nb:CPP, 212Nc:CPP, 212Oa:CCC, 212Oc:CCC, 222Jd:CCC, 222Je:CCC, 222Jg:CCC, 222Lc:CCC, 222Lf:CCC, 222Mc:CCC, 222Md:CCC

Federal Lands: NPS (Pictured Rocks, Saint Croix, Sleeping Bear Dunes); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.9, SLBE.31, SLBE.47, SLBE.50.

Sleeping Bear Dunes National Lakeshore Map Code: FWO

Local Description Authors: M.J. Russo

Global Description Authors: D. Faber-Langendoen

References: Chambers et al. 1997, Chapman et al. 1989, Eyre 1980, Farrand and Bell 1982, MNNHP 1993, Midwestern Ecology Working Group n.d., WNHIP unpubl. data

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White Pine - Aspen - Birch Forest

***Pinus strobus* - *Populus tremuloides / Corylus cornuta* Forest**
Eastern White Pine - Quaking Aspen / Beaked Hazelnut Forest
Identifier: CEGL002479

NVC CLASSIFICATION

Division	Eastern North American Cool Temperate Forest (1.C.2.Na)
Macrogroup	Northern & Eastern Pine - Oak Forest, Woodland & Barrens (M159)
Group	White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group (G025)
Association (Common name)	White Pine - Aspen - Birch Forest
Ecological System(s):	Laurentian-Acadian Northern Pine-(Oak) Forest (CES201.719)

ELEMENT CONCEPT

Global Summary: This white pine - hardwood forest is found in the Great Lakes region of the United States and Canada. Stands are found on a variety of slope positions on deep (>60 cm), dry-mesic to mesic, rapidly drained soils, with fine sandy to loamy soil textures. The tree canopy is mixed evergreen-deciduous. *Pinus strobus* (eastern white pine) may form a supercanopy over a mixture of other species, including *Betula papyrifera* (paper birch), *Populus tremuloides* (quaking aspen), *Picea glauca* (white spruce), and *Abies balsamea* (balsam fir). Less frequent are *Pinus resinosa* (red pine), *Populus grandidentata* (bigtooth aspen), and *Thuja occidentalis* (northern white-cedar). The subcanopy can include *Acer rubrum* (red maple) and *Acer saccharum* (sugar maple), as well as a mixture of canopy species. Tall shrubs and saplings include *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Amelanchier* (serviceberry) spp. and *Corylus cornuta* (beaked hazelnut). Short shrubs include *Diervilla lonicera* (northern bush honeysuckle), *Linnaea borealis* (twinflower), *Lonicera canadensis* (American fly honeysuckle), and *Vaccinium myrtilloides* (velvetleaf huckleberry). *Viburnum nudum* var. *cassinoides* (withe-rod) may be present in the eastern part of the range. Herbs include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Maianthemum canadense* (Canada mayflower), *Oryzopsis asperifolia* (roughleaf ricegrass), *Pteridium aquilinum* (western brackenfern), *Streptopus lanceolatus* var. *longipes* (twistedstalk), and *Trientalis borealis* (starflower). Typical mosses include *Pleurozium schreberi* (Schreber's big red stem moss), *Dicranum polysetum* (dicranum moss) and *Dicranum flagellare* (dicranum moss).

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This white pine - hardwood forest was sampled once in the park. The site is located on the north-facing upper slope of a hill with well-drained loamy sand soil. The unvegetated surface is dominated by leaf litter (95% cover) with some wood (3%) and dead plant stems (2%). No evidence of disturbance was reported.
Global Environment: Stands are found on a variety of slope positions on deep (>60 cm), dry-mesic to mesic, rapidly drained soils, with fine sandy to loamy soil textures (Sims et al. 1989, MNNHP 1993, Chambers et al. 1997).

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The moderate (50% cover) tree canopy, 15-20 m tall, is dominated by *Populus grandidentata* (bigtooth aspen) and includes lesser amounts of *Pinus banksiana* (jack pine), *Pinus resinosa* (red pine), *Pinus strobus* (eastern white pine), *Quercus alba* (white oak), and *Quercus rubra* (northern red oak). The sparse (20%) subcanopy (5-10 m), sparse (20%) tall-shrub layer (2-5 m) and very sparse (5%) short-shrub layer (0.5-1 m) are comprised of *Pinus resinosa* (red pine) and *Pinus strobus* (eastern white pine). *Vaccinium angustifolium* (lowbush blueberry) and *Vaccinium myrtilloides* (velvetleaf huckleberry) form a very sparse (10%) dwarf-shrub layer. The moderate (60%) herbaceous layer is dominated by *Pteridium aquilinum* (western brackenfern); additional herbs include *Carex pensylvanica* (Pennsylvania sedge), *Deschampsia caespitosa* (tufted hairgrass), *Eurybia macrophylla* (bigleaf aster), *Gaultheria procumbens* (eastern teaberry), *Maianthemum canadense* (Canada mayflower), and *Melampyrum lineare* (narrowleaf cowwheat).
Global Vegetation: The tree canopy is mixed evergreen-deciduous. *Pinus strobus* (eastern white pine) may form a supercanopy over a mixture of other species, including *Betula papyrifera* (paper birch), *Populus tremuloides* (quaking aspen), *Picea glauca* (white spruce), and *Abies balsamea* (balsam fir). Less frequent are *Pinus resinosa* (red pine), *Populus grandidentata* (bigtooth aspen), and *Thuja occidentalis* (northern white-cedar). The subcanopy can include *Acer rubrum* (red maple) and *Acer saccharum* (sugar maple), as well as a mixture of canopy species. Tall shrubs and saplings include *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Amelanchier* (serviceberry) spp., and *Corylus cornuta* (beaked hazelnut). Short shrubs include *Diervilla lonicera* (northern bush honeysuckle), *Linnaea borealis* (twinflower), *Lonicera canadensis* (American fly honeysuckle), and *Vaccinium myrtilloides* (velvetleaf huckleberry). *Viburnum nudum* var. *cassinoides* (withe-rod) may be present in the eastern part of the range. Herbs include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Maianthemum canadense* (Canada mayflower), *Oryzopsis asperifolia* (roughleaf ricegrass), *Pteridium aquilinum* (western brackenfern), *Streptopus lanceolatus* (twistedstalk), and *Trientalis borealis* (starflower). Typical mosses include *Pleurozium schreberi* (Schreber's big red stem moss), *Dicranum polysetum* (dicranum moss) and *Dicranum flagellare* (dicranum moss) (Sims et al. 1989, MNNHP 1993, Chambers et al. 1997).

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MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Pinus strobus* (eastern white pine)
Tree canopy	Broad-leaved deciduous tree	*Populus grandidentata* (bigtooth aspen)
Tall shrub/sapling	Needle-leaved shrub	*Pinus strobus* (eastern white pine)
Herb (field)	Dwarf-shrub	*Vaccinium angustifolium* (lowbush blueberry)
Herb (field)	Fern or fern ally	*Pteridium aquilinum* (western brackenfern)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Pinus strobus* (eastern white pine), *Populus grandidentata* (bigtooth aspen), *Pteridium aquilinum* (western brackenfern), *Vaccinium angustifolium* (lowbush blueberry)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4? (3-Oct-1996).

CLASSIFICATION

Classification Confidence: 2 - Moderate

Global Comments: In Wisconsin and Michigan this type can originate as a result of forestry management and natural examples may be rare. In Wisconsin, this type did apparently occur prior to European settlement, but was more variable than what is described here (E. Epstein pers. comm. 1999). An aspen-birch-white pine type has also been recognized by Grigal and Ohmann (1975) [see also Heinselman (1996)], which consists of two subtypes, stands currently with a white pine overstory, and stands formerly with white pine but currently dominated by aspen-birch because of past logging and fire. Thus this type may be a relatively trivial split between pure evergreen white pine forest and pure deciduous aspen-birch types.

Global Similar Associations:

- *Picea glauca - Abies balsamea / Acer spicatum / Rubus pubescens* Forest (CEGL002446)
- *Pinus resinosa / Vaccinium* spp. Forest (CEGL002443)
- *Pinus strobus - (Pinus resinosa) - Quercus rubra* Forest (CEGL002480)
- *Pinus strobus / Acer spicatum - Corylus cornuta* Forest (CEGL002445)--This is essentially the mainly evergreen equivalent.
- *Populus tremuloides - Betula papyrifera - (Acer rubrum, Populus grandidentata)* Forest (CEGL002467)

Global Related Concepts:

- Dry-Mesic Northern Forest - Red Pine-White Pine (Chapman et al. 1989) B
- White Birch-White Pine-Trembling Aspen-Beaked Hazel-Mountain Maple (V23) (Chambers et al. 1997) =
- White Pine Mixedwood (Sims et al. 1989) =

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Otter Creek Trail (west).

Global Range: This white pine - hardwood forest community type is found in the Great Lakes region of the United States and Canada.

Nations: CA, US

States/Provinces: MI, MN:S3, ON, QC, WI:S4S5

USFS Ecoregions (1994/95): 212Ha:CCP, 212Hb:CCP, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCP, 212Hk:CCP, 212Hl:CCP, 212Hm:CCP, 212Hn:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCP, 212Hr:CCC, 212Hs:CCP, 212Ht:CCP, 212Hu:CCP, 212Hv:CCP, 212Hw:CCC, 212Hx:CC?, 212Hy:CCP, 212Ia:CCC, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Jk:CPP, 212Jl:CPP, 212Jn:CPP, 212Jo:CPP, 212Jr:CPP, 212La:CCC, 212Lb:CCC, 212Lc:CCP, 212Ld:CCP, 212Mb:CPP, 212Na:CPP, 212Nb:CPP, 212Nc:CPP, 212:Oa:CCC

Federal Lands: NPS (Apostle Islands, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chippewa, Huron, Huron-Manistee, Manistee?, Ottawa, Superior?)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.4.

Sleeping Bear Dunes National Lakeshore Map Code: FWA

Local Description Authors: M.J. Russo

Global Description Authors: D. Faber-Langendoen

References: Chambers et al. 1997, Chapman et al. 1989, Grigal and Ohmann 1975, Heinselman 1996, MNNHP 1993, Midwestern Ecology Working Group n.d., Sims et al. 1989, WNHIP unpubl. data

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White Pine / Blueberry Dry-Mesic Forest

***Pinus strobus / Vaccinium* spp. Forest**
Eastern White Pine / Blueberry species Forest
Identifier: CEGL002444

NVC CLASSIFICATION

Division	Eastern North American Cool Temperate Forest (1.C.2.Na)
Macrogroup	Northern & Eastern Pine - Oak Forest, Woodland & Barrens (M159)
Group	White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group (G025)
Association (Common name)	White Pine / Blueberry Dry-Mesic Forest
Ecological System(s):	Laurentian-Acadian Northern Pine-(Oak) Forest (CES201.719)

ELEMENT CONCEPT

Global Summary: This dry white pine forest community is found near the western Great Lakes region of the United States and Canada and eastward into the northeastern United States and eastern Canada. Stands occur on sandy soils within glaciated landscapes, such as moraines and till. It may be on flat to moderately sloping topography. Conifers dominate the overstory. *Pinus strobus* (eastern white pine) is the most abundant mature tree species, often found with small to substantial amounts of *Pinus resinosa* (red pine). Scattered *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), and *Populus tremuloides* (quaking aspen) can be found as subcanopy or small canopy trees. The understory contains species such as *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Maianthemum canadense* (Canada mayflower), *Pteridium aquilinum* (western brackenfern), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry). An inland dune ridge variant occurs in Michigan; the overstory contains *Pinus strobus* (eastern white pine) and *Pinus resinosa* (red pine), the shrub layers contain *Vaccinium angustifolium* (lowbush blueberry) and *Arctostaphylos uva-ursi* (kinnikinnick), and *Pteridium aquilinum* (western brackenfern) is common in the understory.

ENVIRONMENTAL DESCRIPTION

Global Environment: This community is found on sandy soils. It occurs most often on glaciated landscapes, such as moraines and till, where sandy pockets occur, and may be on flat to moderately sloping topography (MNNHP 1993). It is also found on somewhat poorly drained sand and clay lakeplains. The inland dune variant occurs on dune ridges.

VEGETATION DESCRIPTION

Global Vegetation: Conifers dominate the overstory. *Pinus strobus* (eastern white pine) is the most abundant mature tree species, often found with small to substantial amounts of *Pinus resinosa* (red pine). Scattered *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), and *Populus tremuloides* (quaking aspen) can be found as subcanopy or small canopy trees. The understory contains species such as *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Maianthemum canadense* (Canada mayflower), *Pteridium aquilinum* (western brackenfern), and *Vaccinium* (blueberry) spp. (MNNHP 1993). An inland dune ridge variant occurs in Michigan; the overstory contains *Pinus strobus* (eastern white pine) and *Pinus resinosa* (red pine), the shrub layers contain *Vaccinium angustifolium* (lowbush blueberry) and *Arctostaphylos uva-ursi* (kinnikinnick), and *Pteridium aquilinum* (western brackenfern) is common in the understory (P. Comer pers. comm. 1996, D. Albert pers. comm. 1996).

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (22-Jun-1998). There are well over 100 occurrences rangewide, but the occurrences tend to be fairly small stands (under 100 acres) because of the somewhat restricted environmental requirements. Few old-growth remnants remain, but several are protected. This community may be dependent on occasional catastrophic fires (with a very long fire-return interval) to allow regeneration of pines instead of gradual succession to other forest types. Fire suppression, grazing, and logging in the last 100 years have substantially reduced the acreage of this forest type.

CLASSIFICATION

Classification Confidence: 1 - Strong
Global Comments: This type is similar to *Pinus resinosa / Vaccinium* spp. Forest (CEGL002443). It occurs on droughty soils, influenced by adjacent moraines. The inland dune variant, found in Saginaw Bay and in Luce County (Two-hearted River), Upper Peninsula, could also be treated as a variant of the Great Lakes Dune Pine Forest, *Pinus banksiana - Pinus resinosa - Pinus strobus* Dune Forest (CEGL002589).
Global Similar Associations:
- *Pinus banksiana - (Quercus ellipsoidalis) / Schizachyrium scoparium* - Prairie Forbs Wooded Herbaceous Vegetation (CEGL002490)
- *Pinus banksiana - Pinus resinosa - Pinus strobus* Dune Forest (CEGL002589)--This is a pine forest on Great Lakes dunes.
- *Pinus resinosa / Vaccinium* spp. Forest (CEGL002443)
- *Pinus strobus / Acer spicatum - Corylus cornuta* Forest (CEGL002445)

Global Related Concepts:
- Dry-Mesic Northern Forest - Red Pine-White Pine (Chapman et al. 1989) B
- Northern Dry Forest (Curtis 1959) B
- SNE Dry oak/pine forest on sandy / gravelly soils (Rawinski 1984) B

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ELEMENT DISTRIBUTION

Global Range: This dry white pine forest community is found in the western Great Lakes region of the United States and Canada. It ranges from northern Minnesota and northwestern Ontario east possibly into Quebec. Its range extent is close to 200,000 square km.
Nations: CA, US
States/Provinces: MI, MN:S2, ON, QC, WI:S3
USFS Ecoregions (1994/95): 212Hb:CCP, 212He:CCP, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hl:CCC, 212Hm:CCC, 212Ho:CCC, 212Hp:CCC, 212Hq:CCP, 212Hr:CCC, 212Hs:CCP, 212Ht:CCP, 212Hu:CCP, 212Hv:CCP, 212Hw:CCP, 212Hy:CCP, 212Ia:CCC, 212Ja:CCP, 212Jb:CCP, 212Jc:CCP, 212Jl:CCP, 212Jm:CCP, 212Jn:CCP, 212Jr:CCC, 212Ka:CCP, 212Kb:CCC, 212Na:CCC, 212Nb:CCP, 212Nc:CCC, 212:Oa:CCC, 222Ma:CCC, 222Mc:CCC, M212:P
Federal Lands: NPS (Apostle Islands, Pictured Rocks, Sleeping Bear Dunes); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron, Huron-Manistee, Manistee?, Nicolet, Ottawa)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: This association was not sampled with plots at Sleeping Bear Dunes NL.
Sleeping Bear Dunes National Lakeshore Map Code: FWP
Local Description Authors: NA
Global Description Authors: J. Drake
References: Albert pers. comm., Chapman et al. 1989, Comer pers. comm., Curtis 1959, MNNHP 1993, Midwestern Ecology Working Group n.d., Rawinski 1984, WNHIP unpubl. data

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M014. Northern Mesic Hardwood & Conifer Forest

G163. Northern Hardwood - Hemlock - White Pine Forest Group

Sugar Maple - Ash - Basswood Northern Rich Mesic Forest

***Acer saccharum - Fraxinus americana - Tilia americana / Acer spicatum / Caulophyllum thalictroides* Forest**

Sugar Maple - White Ash - American Basswood / Mountain Maple / Blue Cohosh Forest

Identifier: CEGL005008

NVC CLASSIFICATION

Division	Eastern North American Cool Temperate Forest (1.C.2.Na)
Macrogroup	Northern Mesic Hardwood & Conifer Forest (M014)
Group	Northern Hardwood - Hemlock - White Pine Forest Group (G163)
Association (Common name)	Sugar Maple - Ash - Basswood Northern Rich Mesic Forest
Ecological System(s):	Laurentian-Acadian Northern Hardwood Forest (CES201.564)

ELEMENT CONCEPT

Global Summary: This rich sugar maple - white ash - basswood forest is found from the northeastern United States and Canada to the central Great Lakes area, south to the High Alleghenies of Virginia and West Virginia. Stands occur on nutrient-rich, mesic or wet-mesic settings on sloped to rolling terrain. Slope bottoms, where colluvium collects, are a common landscape position. The surface soils are deep sand, loamy sand, or loam and may be underlain by sandy clay loam to clay loam. The sites are somewhat poorly drained to well-drained and can have a water table 0.4-2 m below the surface. Small (<1 ha) seep areas that may occur within these forests have soils that are usually saturated. This forest community has a well-developed tree canopy composed of deciduous species. Shrubs are scattered, but the herbaceous stratum is generally extensive. Bryoids are only a minor component of the ground layer, which is predominantly nitrogen-rich sugar maple leaves. *Acer saccharum* (sugar maple) and *Fraxinus americana* (white ash) are the dominant trees; *Tilia americana* (American basswood) is frequent but not necessarily abundant. *Ostrya virginiana* (hophornbeam) is very common as a small tree. *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Fagus grandifolia* (American beech), and *Prunus serotina* (black cherry) are typical associates, in small amounts. *Ulmus rubra* (slippery elm) and *Juglans cinerea* (butternut) are occasional. Shrubs that may be found in this community include *Cornus alternifolia* (alternateleaf dogwood), *Viburnum lantanoides* (hobblebush), *Hamamelis virginiana* (American witch-hazel), *Dirca palustris* (eastern leatherwood), and *Lonicera canadensis* (American fly honeysuckle). The ground flora, including many spring ephemerals, is diverse and consists primarily of nutrient- and light-requiring species. Many of these flower and fruit early in the spring before the tree canopy has fully leafed out. Fern richness is often high. Various sedges are present (particularly the Laxiflorae). These forests are differentiated from less-rich northern hardwood forests, e.g., *Acer saccharum - Betula alleghaniensis - Fagus grandifolia / Viburnum lantanoides* Forest (CEGL006252), primarily by their abundant and diverse herbaceous layer, as well as by the greater prominence of sugar maple and ash in the canopy and reduced importance of beech.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This sugar maple - white ash - basswood forest was sampled at four locations in the park. The sites are located on the midslope of hills with some microtopography and variable slope and aspect. Soils are well-drained sandy loam, sandy clay loam and clay loam. The unvegetated surface is dominated by leaf litter (75-92% cover) with some wood (5-20%), bare soil (0-2%) and dead plant stems (3-5%). Evidence of disturbance includes dead standing and fallen trees and the presence of exotic plants.

Global Environment: In Virginia, stands occur on nutrient-rich, mesic or, sometimes, wet-mesic situations on flat to rolling terrain. The surface soils are deep sand, loamy sand, or loam and underlain by sandy clay loam to clay loam. The sites are somewhat poorly drained to well-drained and can have a water table 0.4-2 m below the surface. In the northern Appalachian region, sites occur in enriched cove and concave slopes within northern hardwood forests. The elevation of known examples ranges from 115-830 m (380-2700 feet). Ground cover is deciduous litter, predominantly of nitrogen-rich sugar maple leaves.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The moderately dense (50-70% cover) tree canopy, 15-35 m tall, is codominated by *Acer saccharum* (sugar maple), *Fraxinus americana* (white ash), and *Tilia americana* (American basswood), as is the sparse to moderately dense (40-70%) subcanopy (10-15 m) which also includes *Ostrya virginiana* (hophornbeam). The very sparse (5-20%) tall-shrub layer (2-5 m) includes saplings of canopy and subcanopy species. The sparse (30%) short-shrub layer (0.5-1 m) includes *Cornus alternifolia* (alternateleaf dogwood), *Lonicera canadensis* (American fly honeysuckle), *Ribes cynosbati* (eastern prickly gooseberry), *Sambucus racemosa* var. *racemosa* (red elderberry), and *Viburnum acerifolium* (mapleleaf viburnum). The dense (70-80%) herbaceous layer is dominated by *Aralia nudicaulis* (wild sarsaparilla) and *Uvularia grandiflora* (largeflower bellwort) and includes *Allium tricoccum* (wild leek), *Arisaema triphyllum* ssp. *triphyllum* (Jack in the pulpit), *Carex eburnea* (bristleleaf sedge), *Carex pedunculata* (longstalk sedge), *Carex rosea* (rosy sedge), *Caulophyllum thalictroides* (blue cohosh), *Dryopteris marginalis* (marginal woodfern), *Elymus canadensis* (Canada wildrye), *Eurybia macrophylla* (bigleaf aster), *Festuca subverticillata* (nodding fescue), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Maianthemum racemosum* ssp. *racemosum* (feathery false lily of the valley), *Oryzopsis asperifolia* (roughleaf ricegrass), *Osmorhiza claytonii* (Clayton's sweetroot),

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Polygonatum pubescens (hairy Solomon's seal), *Trillium grandiflorum* (snow trillium), *Viola pubescens* (downy yellow violet), and others.

Global Vegetation: This forest community has a well-developed tree canopy composed of deciduous species. Shrubs are scattered, but the herbaceous stratum is well-represented. *Acer saccharum* (sugar maple) and *Fraxinus americana* (white ash) are the dominant trees; *Tilia americana* (American basswood) is frequent but not necessarily abundant. *Ostrya virginiana* (hophornbeam) is very common as a small tree. *Quercus rubra* (northern red oak), *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Fagus grandifolia* (American beech), and *Prunus serotina* (black cherry) are typical associates. *Ulmus rubra* (slippery elm) and *Juglans cinerea* (butternut) are occasional. Shrubs that may be found in this community include *Cornus alternifolia* (alternateleaf dogwood), *Viburnum lantanoides* (hobblebush), *Hamamelis virginiana* (American witch-hazel), *Dirca palustris* (eastern leatherwood), and *Lonicera canadensis* (American fly honeysuckle). The ground flora, much of which is spring ephemerals, is diverse and consists primarily of nutrient- and light-requiring species. Many of these flower and fruit early in the spring before the tree canopy has fully leafed out; *Dicentra cucullaria* (Dutchman's breeches), *Dicentra canadensis* (squirrel corn), *Hepatica* (hepatica) spp., *Asarum canadense* (Canadian wildginger), *Caulophyllum thalictroides* (blue cohosh), *Viola canadensis* (Canadian white violet), *Viola rotundifolia* (roundleaf yellow violet), *Actaea pachypoda* (white baneberry), *Osmorhiza claytonii* (Clayton's sweetroot), *Panax quinquefolius* (American ginseng), *Sanguinaria canadensis* (bloodroot), and *Erythronium americanum* (dogtooth violet) are typical. Fern richness is often high, with characteristic species including *Adiantum pedatum* (northern maidenhair), *Cystopteris bulbifera* (bulblet bladderfern), *Deparia acrostichoides* (silver false spleenwort), *Dryopteris goldiana* (Goldie's woodfern), *Dryopteris filix-mas* (male fern), *Dryopteris marginalis* (marginal woodfern), *Botrychium virginianum* (rattlesnake fern), *Athyrium filix-femina* (common ladyfern), *Phegopteris hexagonoptera* (broad beechfern), and, especially in seepy spots, *Matteuccia struthiopteris* (ostrich fern). Various sedges are present (particularly the Laxiflorae group) such as *Carex laxiflora* (broad looseflower sedge), *Carex platyphylla* (broadleaf sedge), *Carex plantaginea* (plantainleaf sedge), *Carex leptonervia* (nerveless woodland sedge), *Carex hitchcockiana* (Hitchcock's sedge), *Carex aestivalis* (summer sedge), *Carex davisii* (Davis' sedge), *Carex bebbii* (Bebb's sedge), and others. The herbaceous flora in seeps often contains *Calamagrostis canadensis* (bluejoint), *Carex scabrata* (eastern rough sedge), *Ageratina altissima* (white snakeroot), *Glyceria melicaria* (melic mannagrass), *Impatiens capensis* (jewelweed) (sometimes *Impatiens pallida* (pale touch-me-not) as well), and *Solidago flexicaulis* (zigzag goldenrod).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer saccharum* (sugar maple)
Tree canopy	Broad-leaved deciduous tree	*Fraxinus americana* (white ash)
Tree subcanopy	Broad-leaved deciduous tree	*Ostrya virginiana* (hophornbeam)
Herb (field)	Forb	*Aralia nudicaulis* (wild sarsaparilla), *Osmorhiza claytonii* (Clayton's sweetroot), *Uvularia grandiflora* (largeflower bellwort)

Global

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer saccharum* (sugar maple)
Tree canopy	Broad-leaved deciduous tree	*Fraxinus americana* (white ash)
Tree subcanopy	Broad-leaved deciduous tree	*Ostrya virginiana* (hophornbeam)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Cornus alternifolia* (alternateleaf dogwood), *Dirca palustris* (eastern leatherwood), *Hamamelis virginiana* (American witch-hazel), *Lonicera canadensis* (American fly honeysuckle), *Viburnum lantanoides* (hobblebush)
Herb (field)	Fern or fern ally	*Adiantum pedatum* (northern maidenhair), *Botrychium virginianum* (rattlesnake fern)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Acer saccharum* (sugar maple), *Aralia nudicaulis* (wild sarsaparilla), *Fraxinus americana* (white ash), *Osmorhiza claytonii* (Clayton's sweetroot), *Ostrya virginiana* (hophornbeam), *Ribes cynosbati* (eastern prickly gooseberry), *Tilia americana* (American basswood), *Uvularia grandiflora* (largeflower bellwort)

Global: *Acer saccharum* (sugar maple), *Adiantum pedatum* (northern maidenhair), *Allium tricoccum* (wild leek), *Botrychium virginianum* (rattlesnake fern), *Cardamine diphylla* (crinkleroot), *Caulophyllum thalictroides* (blue cohosh), *Claytonia caroliniana* (Carolina springbeauty), *Dryopteris goldiana* (Goldie's woodfern), *Fraxinus americana* (white ash), *Milium effusum* (American milletgrass), *Phlox stolonifera* (creeping phlox), *Tiarella cordifolia* (heartleaf foamflower), *Tilia americana* (American basswood), *Viola blanda* (sweet white violet), *Viola canadensis* (Canadian white violet)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Epipactis helleborine* (broadleaf helleborine, exotic, Medium/Low), *Poa compressa* (Canada bluegrass, exotic, High/Low)

Global: Vulnerable: *Panax quinquefolius* (American ginseng, G3G4); **Other**: *Cuscuta rostrata* (beaked dodder, VA S2, G4), *Meleagris gallopavo* (wild turkey, G5)

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CONSERVATION STATUS RANK

Global Rank & Reasons: G4? (28-Sep-2001). This community has a wide geographic distribution, but is locally distributed within its range due to specific requirements for mesic sites with fertile soils. In gentler topographic regions, many examples of this community have probably been destroyed for agriculture, and most remaining examples elsewhere have been altered by past logging. Consequently much of the remaining acreage is of variable quality.

CLASSIFICATION

Classification Confidence: 2 - Moderate

Global Comments: The attribution of this type to the Ridge and Valley subsection is based on the location of a single stand on the westernmost scarp slope of the Ridge Valley (east slope of Middle Mountain) at the Allegheny Front. The status of this association in Maryland is uncertain.

Global Similar Associations:

- *Acer saccharum - (Fraxinus americana) / Arisaema triphyllum* Forest (CEGL006211)
- *Acer saccharum - Betula alleghaniensis - (Tilia americana)* Forest (CEGL002457)
- *Acer saccharum - Betula alleghaniensis - Fagus grandifolia / Viburnum lantanoides* Forest (CEGL006252)
- *Acer saccharum - Fagus grandifolia - Betula* spp. / *Maianthemum canadense* Forest (CEGL005004)

Global Related Concepts:

- *Acer saccharum - Tilia americana - Fagus grandifolia / Caulophyllum thalictroides - Viola blanda - (Allium tricoccum)* Forest (Fleming and Coulling 2001) ?
- *Acer saccharum - Tilia americana / Caulophyllum thalictroides - Laportea canadensis* Association (Fleming and Moorhead 1996) ?
- Dry-Mesic Calcareous Forest (Breden 1989) B
- High-Elevation Cove Forest (Fleming and Coulling 2001) B
- Maple - Basswood - Ash Forest (Gawler 2002) =
- Mesic Northern Forest - Sugar Maple-Basswood (Chapman et al. 1989) =
- Rich Northern Hardwood Forest (Thompson 1996) =
- Rich northern hardwood forest (NAP pers. comm. 1998) ?
- SNE rich mesic forest (circumneutral to basic) (Rawinski 1984) ?
- Sugar Maple - Basswood: 26 (Eyre 1980) B
- Sugar maple-white ash-basswood-bluebead cove forest (CAP pers. comm. 1998) ?

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Pierce Stocking Scenic Drive and Empire Bluff Trail and at Pyramid Point. It is typically found near the Lake Michigan coast on the inland side of the first forested dunes.

Global Range: This forest association ranges generally from Ontario and New England west to Michigan and south to New Jersey and New York, with a discontinuous southward extension in the high Allegheny Mountains to western Virginia and eastern West Virginia.

Nations: CA, US

States/Provinces: CT, MA, MD?, ME:S3, MI:S3, NB, NH:S3, NJ:S2?, NY, ON, PA, QC:S4?, RI, VA:S1, VT:S4, WV:S2S3

USFS Ecoregions (1994/95): 212B:CC, 212D:CC, 212E:C?, 212Fa:CCC, 212Fb:CCC, 212Fc:CCC, 212Fd:CCC, 212Ga:CCC, 212Gb:CCC, 212Hl:CCP, 212Hn:CCP, 212Ho:CCC, 212Hw:CCC, 212Hx:CCP, 212Hy:CCP, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Jl:CPP, 212Jn:CPP, 212Jo:CPP, 212Oa, 221Ae:CCC, 221Af:CCC, 221Ag:CCP, 221Ah:CCP, 221Ai:CCP, 221Al:CCP, 221Ba:CCC, 221Bb:CCC, 221Bc:CCC, 221Bd:CCC, 222Ia:CCP, 222Ib:CCP, 222Ic:CCP, 222Id:CCP, 222Ie:CCP, M212Ad:CCC, M212Ae:CCC, M212Af:CCC, M212Ba:CCC, M212Bb:CCC, M212Bc:CCP, M212Bd:CCP, M212Ca:CCC, M212Cb:CCC, M212Cd:CCC, M212Da:CCC, M212Db:CCP, M212Dc:CCC, M212Dd:CCP, M212De:CCC, M212Df:CCC, M212Ea:CCC, M212Eb:CCC, M212Fa:CPP, M212Fb:CPP, M221Aa:CCC, M221Ba:CCC, M221Bd:CC?

Federal Lands: NPS (Appalachian Trail, Marsh-Billings-Rockefeller, Sleeping Bear Dunes, Upper Delaware); USFS (Finger Lakes, George Washington, Huron-Manistee, Huron?, Manistee, Ottawa, White Mountain)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.14, SLBE.16, SLBE.24, SLBE.45.

Sleeping Bear Dunes National Lakeshore Map Code: FMA

Local Description Authors: M.J. Russo

Global Description Authors: D. Faber-Langendoen, mod. L. Sneddon, G. Fleming, S.C. Gawler

References: Breden 1989, Breden et al. 2001, CAP pers. comm. 1998, Chapman et al. 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Eyre 1980, Fleming and Coulling 2001, Fleming and Moorhead 1996, Fleming et al. 2001, Gawler 2002, Harrison 2004, Metzler and Barrett 2001, Metzler and Barrett 2004, NAP pers. comm. 1998, Rawinski 1984, Sperduto 2000a, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000

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Aspen - Birch - Red Maple Forest

***Populus tremuloides - Betula papyrifera - (Acer rubrum, Populus grandidentata)* Forest**
Quaking Aspen - Paper Birch - (Red Maple, Bigtooth Aspen) Forest
Identifier: CEGL002467

NVC CLASSIFICATION

Division	Eastern North American Cool Temperate Forest (1.C.2.Na)
Macrogroup	Northern Mesic Hardwood & Conifer Forest (M014)
Group	Northern Hardwood - Hemlock - White Pine Forest Group (G163)
Association (Common name)	Aspen - Birch - Red Maple Forest
Ecological System(s):	Boreal Aspen-Birch Forest (CES103.020)
	Laurentian-Acadian Northern Hardwood Forest (CES201.564)

ELEMENT CONCEPT

Global Summary: This aspen - birch - maple forest is found in the upper midwestern United States and southern and central Canada. Sites are on level to rolling topography, and on upper slopes or plateaus or in valley bottoms. The substrate is derived from glacial outwash, lacustrine deposits, or moraines. The soil is typically deep, sandy loam or loamy sand and well-drained. This deciduous forest community has a moderately closed canopy usually dominated by *Populus tremuloides* (quaking aspen) and *Betula papyrifera* (paper birch). *Acer rubrum* (red maple) and *Populus grandidentata* (bigtooth aspen) may be absent to dominant. Other minor components of the overstory may include *Abies balsamea* (balsam fir), *Pinus resinosa* (red pine), *Pinus strobus* (eastern white pine), *Picea glauca* (white spruce), and *Quercus rubra* (northern red oak). The shrub layer is approximately 2 m tall and often well-developed. The most abundant species are *Acer spicatum* (mountain maple), *Amelanchier* (serviceberry) spp., *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), and *Rosa acicularis* (prickly rose). Other shrubs present include *Lonicera canadensis* (American fly honeysuckle), *Rubus pubescens* (dwarf red blackberry), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry). The herbaceous layer tends to contain many species. Common species are *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (starflower), and *Viola* (violet) spp.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This bigtooth aspen forest was sampled at two locations in the park. One site is flat with well-drained loamy sand soil; the other is located on the midslope of a hill with well-drained sandy clay loam soil. The unvegetated surface is dominated by leaf litter (85-92% cover) with some wood (5-10%) and dead plant stems (3-5%). Evidence of disturbance includes dead standing and fallen trees and the presence of exotic plants.

Global Environment: This community is mostly found on level to rolling topography. It can occur on upper slopes or plateaus or in valley bottoms (Ohmann and Ream 1971). The soil is typically deep, sandy loam or loamy sand (Alban et al. 1991). The sites are on glacial outwash, lacustrine deposits, or moraines (Ohmann and Ream 1971, Sims et al. 1989). Most are well-drained, however, this community can be found on somewhat poorly drained sites.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The moderately dense (60-70% cover) tree canopy, 20-35 m tall, is dominated by *Populus grandidentata* (bigtooth aspen) and may include small amounts of *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Fraxinus pennsylvanica* (green ash), *Prunus serotina* (black cherry), and *Quercus rubra* (northern red oak). The moderately dense (50-70%) subcanopy (10-15 m) is dominated by *Acer saccharum* (sugar maple) and may include canopy species as well as *Fagus grandifolia* (American beech) and *Ostrya virginiana* (hophornbeam). The sparse (20-40%) tall-shrub layer (2-5 m) and very sparse (5-30%) short-shrub layer (0.5-1 m) are comprised of saplings of canopy species; additional shrubs include *Hamamelis virginiana* (American witch-hazel) and *Viburnum acerifolium* (mapleleaf viburnum). The very sparse (5-30%) herbaceous layer is made up of tree seedlings and includes *Conopholis americana* (American squawroot), *Epipactis helleborine* (broadleaf helleborine) (exotic), *Maianthemum canadense* (Canada mayflower), *Polygonatum pubescens* (hairy Solomon's seal), *Pteridium aquilinum* (western brackenfern), *Toxicodendron radicans* (eastern poison-ivy), and *Trientalis borealis* (starflower).

Global Vegetation: This deciduous forest community has a moderately closed canopy usually dominated by *Populus tremuloides* (quaking aspen) and *Betula papyrifera* (paper birch). *Acer rubrum* (red maple) and *Populus grandidentata* (bigtooth aspen) may be absent to dominant. Other minor components of the overstory may include *Abies balsamea* (balsam fir), *Pinus resinosa* (red pine), *Pinus strobus* (eastern white pine), *Picea glauca* (white spruce), and *Quercus rubra* (northern red oak). The shrub layer is approximately 2 m tall and often well-developed (MNNHP 1993). The most abundant species are *Acer spicatum* (mountain maple), *Amelanchier* (serviceberry) spp., *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), and *Rosa acicularis* (prickly rose). Other shrubs present include *Lonicera canadensis* (American fly honeysuckle), *Rubus pubescens* (dwarf red blackberry), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry). The herbaceous layer tends to contain many species. Common species include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (starflower), and *Viola* (violet) spp.

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MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Populus grandidentata* (bigtooth aspen)
Tree subcanopy	Broad-leaved deciduous tree	*Acer saccharum* (sugar maple)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Ostrya virginiana* (hophornbeam)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Acer saccharum* (sugar maple), *Conopholis americana* (American squawroot), *Maianthemum canadense* (Canada mayflower), *Ostrya virginiana* (hophornbeam), *Polygonatum pubescens* (hairy Solomon's seal), *Populus grandidentata* (bigtooth aspen), *Viburnum acerifolium* (mapleleaf viburnum)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Epipactis helleborine* (broadleaf helleborine, exotic, Medium/Low), *Poa compressa* (Canada bluegrass, exotic, High/Low)
Global: Other: *Trillium chloropetalum* var. *giganteum* (giant wakerobin, G5T3?)

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (3-Oct-1996).

CLASSIFICATION

Classification Confidence: 2 - Moderate
Global Comments: In Michigan, *Quercus rubra* (northern red oak) may be present. This type can result from removal of conifers by logging; e.g., Wisconsin does not track this type for conservation purposes because it most commonly establishes after logging of spruce-fir stands. Stands with understories of pines or mixed aspen-birch-pines best fit under the mixed evergreen-deciduous types (e.g., white pine - aspen - birch forest, *Pinus strobus - Populus tremuloides / Corylus cornuta* Forest (CEGL002479)).
Global Similar Associations:
- *Pinus strobus - Populus tremuloides / Corylus cornuta* Forest (CEGL002479)
- *Populus tremuloides - Betula papyrifera / (Abies balsamea, Picea glauca)* Forest (CEGL002466)
- *Populus tremuloides - Betula papyrifera / Acer saccharum* - Mixed Hardwoods Forest (CEGL002468)

Global Related Concepts:
- Aspen Hardwood (V5) (Sims et al. 1989) =
- Cloquet Site (Alban et al. 1991) =
- Dry-Mesic Northern Forest - Aspen-Birch (Chapman et al. 1989) =
- Maple (Yellow Birch) Hardwood and Mixedwood (V3.1) (Sims et al. 1997) =
- Maple - Aspen - Birch (Ohmann and Ream 1971) =

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Hyland Road and Shauger Hill Road (near North Bar Lake).
Global Range: This aspen - birch - maple forest is found in the upper midwestern United States and southern and central Canada, ranging from Minnesota and Manitoba east to Michigan, Ontario and possibly Quebec.
Nations: CA, US
States/Provinces: MI:S5, MN:S4?, ON, QC:S5?, WI:S5
USFS Ecoregions (1994/95): 212Ha:CCP, 212Hb:CCP, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCP, 212Hk:CCP, 212Hl:CCC, 212Hn:CCP, 212Ho:CCC, 212Hp:CC?, 212Hw:CCC, 212Ia:CCC, 212Ib:CC?, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Je:CPP, 212Jf:CPP, 212Jj:CPP, 212Jk:CPP, 212Jl:CPP, 212Jm:CPP, 212Jn:CPP, 212Jo:CPP, 212Jr:CPP, 212Ka:CCP, 212Kb:CCC, 212La:CCC, 212Mb:CCC, 212Na:CCP, 212Nb:CCP, 212Nc:CCC, 212Oa:CCC, 222Ma:CCC, 222Md:CCC
Federal Lands: NPS (Apostle Islands, Isle Royale, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron-Manistee?, Huron?, Manistee?, Nicolet, Ottawa, Superior)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.21, SLBE.44.
Sleeping Bear Dunes National Lakeshore Map Code: FBR
Local Description Authors: M.J. Russo
Global Description Authors: J. Drake
References: Alban et al. 1991, Chapman et al. 1989, MNNHP 1993, Midwestern Ecology Working Group n.d., Ohmann and Ream 1971, Sims et al. 1989, Sims et al. 1997, WNHIP unpubl. data

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Northern Red Oak - Sugar Maple Forest

***Quercus rubra - Acer saccharum - (Betula alleghaniensis)* Forest**
Northern Red Oak - Sugar Maple - (Yellow Birch) Forest
Identifier: CEGL002461

NVC CLASSIFICATION

Division	Eastern North American Cool Temperate Forest (1.C.2.Na)
Macrogroup	Northern Mesic Hardwood & Conifer Forest (M014)
Group	Northern Hardwood - Hemlock - White Pine Forest Group (G163)
Association (Common name)	Northern Red Oak - Sugar Maple Forest
Ecological System(s):	Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563)

ELEMENT CONCEPT

Global Summary: This red oak - hardwood forest is found in the sub-boreal/mixed hardwood-conifer region of the Great Lakes, in both the United States and Canada. Stands are found on dry to mesic ridgetops and upper to midslopes, occasionally with bedrock outcrops, and on glacial outwash. Soils are moderately shallow (30-60 cm) to deep, varying from fine sands to loams and clay loams. Dominant species in the tree canopy include *Quercus rubra* (northern red oak), *Acer saccharum* (sugar maple), and *Acer rubrum* (red maple). Associates include *Betula papyrifera* (paper birch), *Betula alleghaniensis* (yellow birch), *Pinus strobus* (eastern white pine), *Populus tremuloides* (quaking aspen), *Populus grandidentata* (bigtooth aspen), and in the eastern part of its range, *Fagus grandifolia* (American beech), *Fraxinus americana* (white ash), and *Ostrya virginiana* (hophornbeam). Subcanopy species typically include the maples. Shrubs include *Amelanchier laevis* (Allegheny serviceberry), *Acer pensylvanicum* (striped maple), *Corylus cornuta* (beaked hazelnut), *Hamamelis virginiana* (American witch-hazel), and *Lonicera canadensis* (American fly honeysuckle). Herbs include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Dryopteris carthusiana* (spinulose woodfern), *Maianthemum canadense* (Canada mayflower), *Mitchella repens* (partridgeberry) (creeping semi-shrub), *Polygonatum pubescens* (hairy Solomon's seal), and *Pteridium aquilinum* (western brackenfern). Diagnostic species include *Quercus rubra* (northern red oak) along with ground layer species typical of the mixed hardwood-conifer region.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This red oak - hardwood forest was sampled at four locations in the park. The sites are located on the midslope of hills and moraines with variable slope and aspect. Soils are well-drained sandy loam, loamy sand and sandy clay loam and rapidly drained sand. The unvegetated surface is dominated by leaf litter (80-92% cover) with some wood (3-5%), bare soil (0-3%) and dead plant stems (3-15%). Evidence of disturbance includes trails and roads, dead standing and fallen trees and the presence of exotic plants.

Global Environment: Stands are found on glacial till (end and ground moraines), mesic portions of glacial outwash and glacial lakebeds, and, farther north, on dry to mesic ridgetops and upper to midslopes, occasionally with bedrock outcrops. Soils are moderately shallow (30-60 cm) to deep, varying from fine sands to loams and clay loams (Nowacki et al. 1990, Chambers et al. 1997). Site characteristics are well-described in central Ontario by Chambers et al. (1997) (ecosites 23.1 and 23.2).

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The moderate to very dense (60-90% cover) tree canopy, 15-35+ m tall, is dominated by *Quercus rubra* (northern red oak) along with lesser amounts of *Acer saccharum* (sugar maple), *Betula papyrifera* (paper birch), *Fraxinus americana* (white ash), and/or *Populus grandidentata* (bigtooth aspen). The sparse to moderate (10-60%) subcanopy (5-20 m) is made up of canopy species and may include *Ostrya virginiana* (hophornbeam). The sparse to moderate (10-60%) tall-shrub layer (2-5 m) is dominated by *Fagus grandifolia* (American beech), as is the very sparse to dense (5-80%) short-shrub layer (0.5-2 m); *Viburnum acerifolium* (mapleleaf viburnum) codominates the short-shrub layer which may also include *Acer pensylvanicum* (striped maple), *Hamamelis virginiana* (American witch-hazel), *Juniperus communis* (common juniper), *Prunus serotina* (black cherry), *Prunus virginiana* (chokecherry), *Sorbus decora* (northern mountain-ash), and *Toxicodendron rydbergii* (western poison-ivy). The sparse to very dense (20-90%) herbaceous layer is dominated by tree seedlings and may include *Aralia nudicaulis* (wild sarsaparilla), *Carex* (sedge) spp., *Conopholis americana* (American squawroot), *Eurybia macrophylla* (bigleaf aster), *Maianthemum canadense* (Canada mayflower), *Maianthemum racemosum* ssp. *racemosum* (feathery false lily of the valley), *Mitchella repens* (partridgeberry), *Polygonatum pubescens* (hairy Solomon's seal), *Pteridium aquilinum* (western brackenfern), and others.

Global Vegetation: The canopy is dominated by deciduous trees. Dominant species in the canopy include *Quercus rubra* (northern red oak), *Acer saccharum* (sugar maple), and *Acer rubrum* (red maple). Associates include *Betula papyrifera* (paper birch), *Betula alleghaniensis* (yellow birch), *Pinus strobus* (eastern white pine), *Populus tremuloides* (quaking aspen), *Populus grandidentata* (bigtooth aspen), and in the eastern part of its range, *Fagus grandifolia* (American beech), *Fraxinus americana* (white ash), and *Ostrya virginiana* (hophornbeam). Subcanopy species typically include the maples. Shrubs include *Amelanchier laevis* (Allegheny serviceberry), *Acer pensylvanicum* (striped maple), *Corylus cornuta* (beaked hazelnut), and *Lonicera canadensis* (American fly honeysuckle). Herbs include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Dryopteris carthusiana* (spinulose woodfern), *Maianthemum canadense* (Canada mayflower), *Mitchella repens* (partridgeberry) (creeping semi-shrub), *Polygonatum pubescens* (hairy Solomon's seal), and *Pteridium aquilinum* (western brackenfern). Diagnostic species include *Quercus rubra* (northern red oak) with ground layer species typical of the mixed hardwood/conifer region (Chambers et al. 1997).

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MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Quercus rubra* (northern red oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Fagus grandifolia* (American beech)
Short shrub/sapling	Broad-leaved deciduous shrub	*Viburnum acerifolium* (mapleleaf viburnum)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Acer saccharum* (sugar maple), *Fagus grandifolia* (American beech), *Polygonatum pubescens* (hairy Solomon's seal), *Quercus rubra* (northern red oak), *Viburnum acerifolium* (mapleleaf viburnum)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Epipactis helleborine* (broadleaf helleborine, exotic, Medium/Low)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (14-Aug-2009). This type often arises after logging or logging and fire, and may be as common, or more so, as it was prior to European settlement.

CLASSIFICATION

Classification Confidence: 2 - Moderate

Global Comments: This association is similar to *Quercus rubra - (Acer saccharum, Quercus alba)* Forest (CEGL005017), which is more southerly and lacks northern trees such as *Betula alleghaniensis* (yellow birch) and possibly *Betula papyrifera* (paper birch). This association (CEGL002461) is found in Province 212 while CEGL005017 is limited to Province 222. See also *Quercus rubra - Acer saccharum - Fagus grandifolia / Viburnum acerifolium* Forest (CEGL006173) in the East. Compare with *Quercus rubra - Quercus alba - (Quercus velutina, Acer rubrum) / Viburnum acerifolium* Forest (CEGL002462), which is more dry. Because the type is thought to have originated through logging and burning of pine stands (at least in Minnesota), its composition is fairly generic. In the Manistee National Forest ecological land type classification, see ELTP 40, 42, 43 (Cleland et al. 1994).

Global Similar Associations:

- *Acer saccharum - Betula alleghaniensis - Quercus rubra / Viburnum acerifolium* Forest (CEGL006943)--is found in the northeastern United States.
- *Acer saccharum - Fagus grandifolia - Betula* spp. / *Maianthemum canadense* Forest (CEGL005004)
- *Quercus rubra - (Acer saccharum, Quercus alba)* Forest (CEGL005017)--is found south of CEGL002461 in Province 222.
- *Quercus rubra - Acer saccharum - Fagus grandifolia / Viburnum acerifolium* Forest (CEGL006173)--is found in the northeastern United States.
- *Quercus rubra - Quercus alba - (Quercus velutina, Acer rubrum) / Viburnum acerifolium* Forest (CEGL002462)

Global Related Concepts:

- Mesic Northern Forest - Beech-Sugar Maple-Yellow Birch (Chapman et al. 1989) ?
- Red Oak-Sugar Maple-Ironwood-Fly Honeysuckle (V6) (Chambers et al. 1997) =

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Shauger Hill Road, Otter Creek Trail and the trail to Popples Campground and on North Manitou Island.

Global Range: This red oak-hardwood community is found in the sub-boreal/mixed hardwood-conifer region of the Great Lakes, in both the United States and Canada, ranging from northeastern Minnesota east to Wisconsin, Michigan, and Ontario.

Nations: CA, US

States/Provinces: MI, MN:S3, ON, QC:S4?, WI

USFS Ecoregions (1994/95): 212Hc:CCC, 212Ho:CCC, 212Hw:CCC, 212Ia:CCC, 212Jd:CCC, 212Jj:CCC, 212Jl:CC?, 212K:CC, 212Lb:CCC, 212Na:C??, 212Nb:C?? , 212:Oa:CCC

Federal Lands: NPS (Apostle Islands, Isle Royale, Saint Croix, Sleeping Bear Dunes); USFS (Chequamegon-Nicolet?, Chequamegon?, Chippewa?, Huron-Manistee?, Huron?, Manistee?, Nicolet?)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.3, SLBE.43, SLBE.98, SLBE.110.

Sleeping Bear Dunes National Lakeshore Map Code: FOM

Local Description Authors: M.J. Russo

Global Description Authors: D. Faber-Langendoen, mod. J. Drake

References: Chambers et al. 1997, Chapman et al. 1989, Cleland et al. 1994, Kost et al. 2007, MNNHP 1993, Midwestern Ecology Working Group n.d., Nowacki et al. 1990, WNHIP unpubl. data

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White-cedar - Boreal Conifer Mesic Forest

***Thuja occidentalis / Abies balsamea - Acer spicatum* Forest**
Northern White-cedar / Balsam Fir - Mountain Maple Forest
Identifier: CEGL002449

NVC CLASSIFICATION

Division	Eastern North American Cool Temperate Forest (1.C.2.Na)
Macrogroup	Northern Mesic Hardwood & Conifer Forest (M014)
Group	Northern Hardwood - Hemlock - White Pine Forest Group (G163)
Association (Common name)	White-cedar - Boreal Conifer Mesic Forest
Ecological System(s):	Laurentian-Acadian Northern Hardwood Forest (CES201.564)

ELEMENT CONCEPT

Global Summary: This sub-boreal upland northern white-cedar forest occurs in the northern Great Lakes region of the United States and Canada, and occasionally eastward into northern New England. Stands are found on gentle wet-mesic slopes to very steep well-drained slopes, or in the eastern portion of the range on moderately well-drained flats. The predominant aspect is north to northeast. Soils are fine to moderately coarse-textured, usually calcareous, moderately deep to deep (50-100 cm), and often contain boulders at the surface. The overstory is dominated by coniferous trees, with or without a substantial deciduous component. *Thuja occidentalis* (northern white-cedar) is the most abundant tree and may occur in pure stands. Other canopy species include *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Picea glauca* (white spruce), *Picea mariana* (black spruce), *Populus tremuloides* (quaking aspen), and *Pinus strobus* (eastern white pine). There is usually an abundant shrub/sapling layer with saplings of *Thuja occidentalis* (northern white-cedar) and *Abies balsamea* (balsam fir) along with *Acer pensylvanicum* (striped maple) and the shrubs *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), *Linnaea borealis* (twinflower), *Lonicera canadensis* (American fly honeysuckle), *Rubus pubescens* (dwarf red blackberry), and *Sorbus decora* (northern mountain-ash). *Vaccinium angustifolium* (lowbush blueberry) and *Viburnum nudum* var. *cassinoides* (withe-rod) may be present on more acidic sites. The ground layer is typically diverse on mesic to wet-mesic stands and less so on drier stands. Wet-mesic stands can contain a hummock-and-hollow topography, with a seasonally saturated hydrology. Typical species include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), *Trillium undulatum* (painted trillium), and *Trientalis borealis* (starflower). Mosses include *Sanionia uncinata* (sanionia moss), *Hylocomium splendens* (splendid feather moss), *Plagiomnium cuspidatum* (toothed plagiomnium moss), *Pleurozium schreberi* (Schreber's big red stem moss), *Ptilium crista-castrensis* (knights plume moss), and *Rhytidiadelphus triquetrus* (rough gooseneck moss) and, in wetter phases of the type, *Sphagnum* (sphagnum) spp.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This northern white-cedar forest was sampled at four locations in the park. Sites are located on low dune ridges and back dunes with variable slope and aspect. Soils are well-drained loamy sand and moderately well-drained to rapidly drained sand. The unvegetated surface is dominated by leaf litter (13-94% cover) or bare sand (0-70%) with some wood (25%), dead plant stems (0-20%), lichens (0-3%) and mosses (0-7%). Evidence of disturbance includes dead standing trees, wind erosion and the presence of exotic plants.

Global Environment: This community is found on gentle wet-mesic slopes to very steep well-drained slopes (MNNHP 1993). The predominant aspect is north to northeast. Soils are moderately deep to deep (50-100 cm), calcareous, coarse- to fine-textured, and often contain boulders at the surface (Ohmann and Ream 1971, Sims et al. 1989).

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The moderate to very dense (50-90% cover) tree canopy, 10-20 m tall, is dominated by *Thuja occidentalis* (northern white-cedar) and may include substantial amounts of *Pinus resinosa* (red pine) and/or *Pinus strobus* (eastern white pine) as well as lesser amounts of *Abies balsamea* (balsam fir), *Acer saccharum* (sugar maple), *Betula papyrifera* (paper birch), *Picea glauca* (white spruce), *Quercus rubra* (northern red oak), and/or *Tsuga canadensis* (eastern hemlock). A subcanopy (5-10 m) may be absent or sparse to moderate (30-50%) and include canopy species as well as *Cornus rugosa* (roundleaf dogwood) and *Prunus virginiana* (chokecherry). In one stand, *Thuja occidentalis* (northern white-cedar) forms a very dense (97.5%) tall-shrub layer (2-5 m). In other stands, the tall-shrub layer may be absent or sparse to moderate (30-60%) and include saplings of species found in the upper layers. The sparse (20-30%) short-shrub layer (0.5-2 m) may include *Acer saccharum* (sugar maple), *Acer spicatum* (mountain maple), *Juniperus communis* (common juniper), *Lonicera canadensis* (American fly honeysuckle), *Prunus virginiana* (chokecherry), *Symphoricarpos albus* (common snowberry), *Taxus canadensis* (Canada yew), and *Thuja occidentalis* (northern white-cedar). *Arctostaphylos uva-ursi* (kinnikinnick), *Juniperus horizontalis* (creeping juniper), and/or *Toxicodendron rydbergii* (western poison-ivy) may form a very sparse to sparse (5-30%) dwarf-shrub layer. The herbaceous layer is very sparse (5-10%) due to the density of the upper layers but may include *Aquilegia canadensis* (red columbine), *Aralia nudicaulis* (wild sarsaparilla), *Carex eburnea* (bristleleaf sedge), *Chimaphila umbellata* (pipsissewa), *Elymus canadensis* (Canada wildrye), *Eurybia macrophylla* (bigleaf aster), *Fragaria virginiana* (Virginia strawberry), *Galium triflorum* (fragrant bedstraw), *Goodyera oblongifolia* (western rattlesnake plantain), *Linnaea borealis* (twinflower), *Lithospermum caroliniense* (Carolina puccoon), *Maianthemum canadense* (Canada mayflower), *Maianthemum stellatum* (starry false lily of the valley), *Oryzopsis asperifolia* (roughleaf ricegrass),

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Polygala paucifolia (gaywings), *Polygonatum pubescens* (hairy Solomon's seal), *Pteridium aquilinum* (western brackenfern), and *Trientalis borealis* (starflower). Nonvascular species (mosses) cover 5% or less of the ground surface.

Global Vegetation: The overstory is dominated by coniferous trees, with or without a substantial deciduous component. *Thuja occidentalis* (northern white-cedar) is the most abundant tree and may occur in pure stands. Usually there are other canopy species, especially *Abies balsamea* (balsam fir), *Betula papyrifera* (paper birch), *Picea glauca* (white spruce), *Picea mariana* (black spruce), *Populus tremuloides* (quaking aspen), and *Pinus strobus* (eastern white pine). There is usually an abundant shrub/sapling layer with saplings of *Thuja occidentalis* (northern white-cedar) and *Abies balsamea* (balsam fir) along with the shrubs *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), *Linnaea borealis* (twinflower), *Lonicera canadensis* (American fly honeysuckle), *Rubus pubescens* (dwarf red blackberry), and *Sorbus decora* (northern mountain-ash). The ground layer is typically diverse on mesic to wet-mesic stands and less so on steep drier stands. Wet-mesic stands can contain a hummock-and-hollow topography, with a seasonally saturated hydrology. Typical species include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), and *Trientalis borealis* (starflower). Mosses include *Sanionia uncinata* (sanionia moss), *Hylocomium splendens* (splendid feather moss), *Plagiomnium cuspidatum* (toothed plagiomnium moss), *Pleurozium schreberi* (Schreber's big red stem moss), *Ptilium crista-castrensis* (knights plume moss), and *Rhytidiadelphus triquetrus* (rough gooseneck moss) and, in wetter phases of the type, *Sphagnum* (sphagnum) spp. (Ohmann and Ream 1971, Sims et al. 1989, MNNHP 1993, Chambers et al. 1997).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Thuja occidentalis* (northern white-cedar)
Tree subcanopy	Needle-leaved tree	*Abies balsamea* (balsam fir), *Thuja occidentalis* (northern white-cedar)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Abies balsamea* (balsam fir), *Maianthemum canadense* (Canada mayflower), *Maianthemum stellatum* (starry false lily of the valley), *Prunus virginiana* (chokecherry), *Thuja occidentalis* (northern white-cedar)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Epipactis helleborine* (broadleaf helleborine, exotic, Medium/Low)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (3-Oct-1996).

CLASSIFICATION

Classification Confidence: 1 - Strong

Global Comments: This type has a wet-mesic phase that can be difficult to distinguish from cedar swamps, such as *Thuja occidentalis - (Picea mariana, Abies balsamea) / Alnus incana* Forest (CEGL002456). [See also Harris et al. (1996) who consider W32, a northern white-cedar swamp, to be equivalent to V21, a northern white-cedar upland type, of Sims et al. (1989).] Type is equivalent in concept to V21 of Sims et al. (1989) and V21 Chambers et al. (1997). In Wisconsin, stands of this type are best developed near the Great Lakes shore, but the type concept is still not clear. Those stands may still best go with either *Thuja occidentalis - Betula alleghaniensis* Forest (CEGL002450) or *Thuja occidentalis - (Betula alleghaniensis, Tsuga canadensis)* Forest (CEGL002595).

Global Similar Associations:

- *Thuja occidentalis - (Betula alleghaniensis, Tsuga canadensis)* Forest (CEGL002595)
- *Thuja occidentalis - (Picea mariana, Abies balsamea) / Alnus incana* Forest (CEGL002456)
- *Thuja occidentalis - Betula alleghaniensis* Forest (CEGL002450)--This is the mixed conifer-hardwood equivalent

Global Related Concepts:

- Boreal Forest (Chapman et al. 1989) B
- Cedar (inc. Mixedwood) / Mountain Maple Forest (V21) (Sims et al. 1989) =
- Lowland lakeshore northern white cedar forest (NAP pers. comm. 1998) ?
- White Cedar Type (Grigal and Ohmann 1975) =
- White Cedar-Trembling Aspen-White Spruce-Twinflower (V21) (Chambers et al. 1997) =

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Old Indian Trail and on North Manitou Island and South Manitou Island.

Global Range: This sub-boreal upland northern white-cedar forest type occurs in the northern Great Lakes region of the United States and Canada, east to upstate New York and northern New England.

Nations: CA, US

States/Provinces: MI, MN, NH:S1, NY, ON, QC?, WI

USFS Ecoregions (1994/95): 212He:CCC, 212Hi:CCC, 212Hj:CCP, 212Hl:CCC, 212Ho:CCC, 212Hr:CCP, 212Hw:CCC, 212Ia:CCC, 212Ib:CCC, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Jl:CPP, 212Jn:CPP, 212Jo:CPP, 212La:CCC, 212Lb:CCC,

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212Lc:CCC, 212Ld:CC?, 212Mb:CCC, 212Na:CCC, 212Nb:CCP, 212Nc:CC?, 212Oa:CCC, 212Ob:CCC, 212Pa:CCC, 222Na:CCC, M212Ae:CCC

Federal Lands: NPS (Apostle Islands, Grand Portage, Isle Royale, Pictured Rocks, Sleeping Bear Dunes, Voyageurs); USFS (Chippewa, Huron, Huron-Manistee, Manistee?, Ottawa, Superior)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.26, SLBE.93, SLBE.101, SLBE.116.

Sleeping Bear Dunes National Lakeshore Map Code: FCC, FCB. FCM

Local Description Authors: M.J. Russo

Global Description Authors: J. Drake

References: Chambers et al. 1997, Chapman et al. 1989, Edinger et al. 2002, Grigal and Ohmann 1975, MNNHP 1993, Midwestern Ecology Working Group n.d., NAP pers. comm. 1998, Ohmann and Ream 1971, Sims et al. 1989, Sperduto 2000a, WNHIP unpubl. data

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Hemlock Mesic Forest

***Tsuga canadensis* - *(Betula alleghaniensis)* Forest**
Eastern Hemlock - (Yellow Birch) Forest
Identifier: CEGL002598

NVC CLASSIFICATION

Division	Eastern North American Cool Temperate Forest (1.C.2.Na)
Macrogroup	Northern Mesic Hardwood & Conifer Forest (M014)
Group	Northern Hardwood - Hemlock - White Pine Forest Group (G163)
Association (Common name)	Hemlock Mesic Forest
Ecological System(s):	Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563)

ELEMENT CONCEPT

Global Summary: This mesic hemlock evergreen forest is found in the Great Lakes region of the United States and Canada. Stands occur on deep, acidic soils that may be poorly drained. The overstory of this community is strongly dominated by *Tsuga canadensis* (eastern hemlock), typically around 25 m tall. *Betula alleghaniensis* (yellow birch) is often present in the canopy and subcanopy, but at less than 25% cover. Other species that are a minor component of the canopy include *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Pinus strobus* (eastern white pine), *Tilia americana* (American basswood), and *Thuja occidentalis* (northern white-cedar). The sapling layer may also contain *Abies balsamea* (balsam fir) and *Thuja occidentalis* (northern white-cedar), especially in canopy gaps. Shrubs are rare and herbaceous species only moderately abundant under the dense evergreen canopy; however, where gaps occur, *Acer pensylvanicum* (striped maple), *Acer spicatum* (mountain maple), *Amelanchier* (serviceberry) spp., *Gaultheria procumbens* (eastern teaberry), *Lonicera canadensis* (American fly honeysuckle), and *Rubus idaeus* (American red raspberry) may be moderately abundant. The herbaceous layer is poor under drier, more evergreen stands, and richer under more moist and somewhat deciduous stands. Herbaceous species found in this community include *Aralia nudicaulis* (wild sarsaparilla), *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Huperzia lucidula* (shining clubmoss), *Maianthemum canadense* (Canada mayflower), *Oxalis montana* (mountain woodsorrel), *Pteridium aquilinum* (western brackenfern), *Streptopus lanceolatus* var. *longipes* (twistedstalk), and *Trientalis borealis* (starflower). A sparse to dense moss layer includes *Brachythecium reflexum* (brachythecium moss), *Callicladium haldanianum* (callicladium moss), *Dicranum flagellare* (dicranum moss), *Dicranum montanum* (montane dicranum moss), *Mnium marginatum* (olivegreen calcareous moss), *Plagiothecium laetum* (plagiothecium moss), *Polytrichum commune* (polytrichum moss), *Ptilidium pulcherrimum*, and *Tetraphis pellucida* (tetraphis moss).

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This mesic hemlock forest was sampled twice in the park. The sites are located on a moderate west-facing lower moraine and the upper slope of a hill/ridge. Soils are well-drained to rapidly drained sandy loam. The unvegetated surface is dominated by leaf litter (75-98% cover) with some wood (1-5%), dead plant stems (1-15%) and mosses (0-5%). Evidence of disturbance includes the presence of exotic plants. One stand is old-growth and in pristine condition.
Global Environment: This community is found on acidic soils that may be poorly drained. Coffman and Willis (1977) found this community on sandy loam and loams that averaged 115 cm deep and had a fragipan at 45-70 cm. This community may be found on shallow soils in the Huron Mountains of upper Michigan (P. Comer pers. comm. 1996).

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The dense (70-80% cover) tree canopy, 15-35 m tall, is dominated by *Tsuga canadensis* (eastern hemlock) along with lesser amounts of *Betula papyrifera* (paper birch). The sparse (30-40%) subcanopy (10-15 m) is also dominated by *Tsuga canadensis* (eastern hemlock) and may include *Acer saccharum* (sugar maple), *Fagus grandifolia* (American beech), *Ostrya virginiana* (hophornbeam), and *Thuja occidentalis* (northern white-cedar). One stand lacks any shrub layers; the other has very sparse (5%) tall-shrub (1-2 m) and short-shrub (0.5-1 m) layers dominated by *Acer pensylvanicum* (striped maple) along with sapling of tree species. The very sparse (<5-20%) herbaceous layer include *Actaea pachypoda* (white baneberry), *Dryopteris marginalis* (marginal woodfern), *Epipactis helleborine* (broadleaf helleborine) (exotic), *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (starflower), and *Veronica officinalis* (common gypsyweed). One stand has 60% cover of *Leucobryum glaucum* (leucobryum moss).
Global Vegetation: The overstory of this community is strongly dominated by *Tsuga canadensis* (eastern hemlock), typically around 25 m tall (Martin 1959a). *Betula alleghaniensis* (yellow birch) is often present in the canopy and subcanopy, but at less than 25% cover. Other species that are a minor component of the canopy include *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Pinus strobus* (eastern white pine), *Tilia americana* (American basswood), and *Thuja occidentalis* (northern white-cedar). The sapling layer may also contain *Abies balsamea* (balsam fir) and *Thuja occidentalis* (northern white-cedar), especially in canopy gaps (Martin 1959a). Shrubs are rare and herbaceous species only moderately abundant under the dense evergreen canopy; however, where gaps occur, *Acer pensylvanicum* (striped maple), *Acer spicatum* (mountain maple), *Amelanchier* (serviceberry) spp., *Gaultheria procumbens* (eastern teaberry), *Lonicera canadensis* (American fly honeysuckle), and *Rubus idaeus* (American red raspberry) may be moderately abundant. The herbaceous layer is poor under drier, more evergreen stands, and richer under more moist and somewhat deciduous stands. Herbaceous species found in this community include *Aralia nudicaulis* (wild sarsaparilla), *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), *Cornus canadensis* (bunchberry dogwood),

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Dryopteris carthusiana (spinulose woodfern), *Huperzia lucidula* (shining clubmoss), *Maianthemum canadense* (Canada mayflower), *Oxalis montana* (mountain woodsorrel), *Pteridium aquilinum* (western brackenfern), *Streptopus lanceolatus* (twistedstalk), and *Trientalis borealis* (starflower). A sparse to dense moss layer includes *Brachythecium reflexum* (brachythecium moss), *Callicladium haldanianum* (callicladium moss), *Dicranum flagellare* (dicranum moss), *Dicranum montanum* (montane dicranum moss), *Mnium marginatum* (olivegreen calcareous moss), *Plagiothecium laetum* (plagiothecium moss), *Polytrichum commune* (polytrichum moss), *Ptilidium pulcherrimum*, and *Tetraphis pellucida* (tetraphis moss). Liverworts may include *Bazzania trilobata* and *Jamesoniella autumnalis* (Chambers et al. 1997).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Tsuga canadensis* (eastern hemlock)
Nonvascular	Moss	*Leucobryum glaucum* (leucobryum moss)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Betula papyrifera* (paper birch), *Leucobryum glaucum* (leucobryum moss), *Tsuga canadensis* (eastern hemlock)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Epipactis helleborine* (broadleaf helleborine, exotic, Medium/Low)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (24-Oct-2002). This mesic hemlock evergreen forest has a moderately wide range, being found fairly commonly in the Great Lakes region of the United States and Canada. It does not require particularly specific environmental factors, and there may be a large number of Element Occurrences. Under natural conditions many stands would be expected to be in a variety of old-growth conditions, but, at this time, the area occupied by such stands is a relatively small percentage of their former area (Frelich 1995).

CLASSIFICATION

Classification Confidence: 1 - Strong

Global Comments: This type varies from almost pure *Tsuga canadensis* (eastern hemlock) to more of a mix with *Betula alleghaniensis* (yellow birch), but the deciduous component is generally less than 25% cover (see e.g., Chambers et al. 1997, Ecosite 30.1 and 30.2). If hardwoods exceed 25%, the type is placed in *Tsuga canadensis - Acer saccharum - Betula alleghaniensis* Forest (CEGL005044), but logged stands, or remnants that occur in a matrix of secondary growth hardwoods, can be difficult to assign. Chambers et al. (1997) recognize a moist and a dry type in central Ontario. Those are treated as variants of the one type here. In Michigan this type is on the clay lakeplain in the western Upper Peninsula and in the Saginaw Bay Lakeplain. The data by Rogers (1980), who examined pure hemlock stands (many of them less than 2 ha in size) from Wisconsin to Nova Scotia, make clear that there are few species strictly associated with a pure hemlock versus a mixed hemlock-hardwood type, and also indicate that some distinction between a Great Lakes versus northeastern United States/eastern Canada has some merit, as done for the mixed hemlock-hardwood type (CEGL005044 versus *Tsuga canadensis - (Betula alleghaniensis) - Picea rubens / Cornus canadensis* Forest (CEGL006129)). No pure evergreen hemlock type is currently recognized in the northeast because of its small patch size.

Global Similar Associations:

- *Tsuga canadensis - Acer saccharum - Betula alleghaniensis* Forest (CEGL005044)

Global Related Concepts:

- *Tsuga-Coptis* Association (Coffman and Willis 1977) =
- *Tsuga* Forest, Stands He1 and He2 (Martin 1959a) =
- CNE mesic conifer [transition] forest on acidic bedrock/till (Rawinski 1984) B
- Eastern Hemlock: 23 (Eyre 1980) B
- Hemlock - Yellow Birch: 24 (Eyre 1980) B
- Hemlock Forest (Thompson 1996) B
- Hemlock-Spinulose Wood Fern-Herb Poor (V19) (Chambers et al. 1997) F
- Hemlock-Yellow Birch-Goldthread-Wood Sorrel (V18) (Chambers et al. 1997) F
- Mesic Northern Forest - Hemlock-Yellow Birch (Chapman et al. 1989) =

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled at Alligator Hill and on North Manitou Island (Lake Manitou).

Global Range: This mesic hemlock evergreen forest is found in the Great Lakes region of the United States and Canada, ranging from Wisconsin and Michigan to Ontario. Range extent is about 300,000 square km.

Nations: CA, US

States/Provinces: MI:S3, ON, WI:S3S4

USFS Ecoregions (1994/95): 212Hb:CC?, 212Hh:CCP, 212Hi:CCC, 212Hl:CCC, 212Ho:CCC, 212Hw:CCC, 212Ia:CCC, 212Ja:CCC, 212Jb:CCC, 212Jc:CCC, 212Je:CCC, 212Jf:CCC, 212Jj:CCC, 212Jl:CCC, 212Jm:CCC, 212Jn:CCP, 212Jo:CCP, 212Js:CCC, 212:Oa:CCC, 222Ja:CCC, 222Je:CCC, 222Ld:CCC

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Federal Lands: NPS (Apostle Islands, Pictured Rocks, Sleeping Bear Dunes); USFS (Chequamegon-Nicolet, Chequamegon?, Hiawatha?, Nicolet, Ottawa)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.40, SLBE.106.
Sleeping Bear Dunes National Lakeshore Map Code: FHC
Local Description Authors: M.J. Russo
Global Description Authors: J. Drake
References: Chambers et al. 1997, Chapman et al. 1989, Coffman and Willis 1977, Comer pers. comm., Eyre 1980, Frelich 1995, Frelich and Lorimer 1991a, Martin 1959a, Midwestern Ecology Working Group n.d., Rawinski 1984, Rogers 1980, Thompson 1996, Thompson and Sorenson 2000, Tyrrell and Crow 1994, WNHIP unpubl. data

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Great Lakes Hemlock - Beech - Hardwood Forest

***Tsuga canadensis - Fagus grandifolia - (Acer saccharum)* Great Lakes Forest**
Eastern Hemlock - American Beech - (Sugar Maple) Great Lakes Forest
Identifier: CEGL005042

NVC CLASSIFICATION

Division	Eastern North American Cool Temperate Forest (1.C.2.Na)
Macrogroup	Northern Mesic Hardwood & Conifer Forest (M014)
Group	Northern Hardwood - Hemlock - White Pine Forest Group (G163)
Association (Common name)	Great Lakes Hemlock - Beech - Hardwood Forest
Ecological System(s):	Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563)

ELEMENT CONCEPT

Global Summary: This hemlock - beech hardwood forest is found in the central Great Lakes region of the United States and Canada. Stands may be found on flat to moderately steep slopes of any aspect. Soils are primarily dry-mesic to mesic loams and sands and sometimes loamy silt. The overstory is typically a closed canopy dominated by *Tsuga canadensis* (eastern hemlock) and either *Acer saccharum* (sugar maple) or *Fagus grandifolia* (American beech). *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Fraxinus americana* (white ash), *Pinus strobus* (eastern white pine), *Quercus rubra* (northern red oak), and *Ulmus americana* (American elm) also can be found in the canopy. Along with smaller individuals of the canopy species, *Abies balsamea* (balsam fir), *Ostrya virginiana* (hophornbeam), and *Picea glauca* (white spruce) can often be found in the undergrowth in Upper Michigan. The shrub layer is usually not well-developed and includes such species as *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Hamamelis virginiana* (American witch-hazel), and *Lonicera canadensis* (American fly honeysuckle). The herbaceous layer may contain few to many species. Herbaceous species, such as *Anemone quinquefolia* (nightcaps), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Maianthemum canadense* (Canada mayflower), *Maianthemum racemosum* (feathery false lily of the valley), *Medeola virginiana* (Indian cucumber), *Trientalis borealis* (starflower), *Trillium grandiflorum* (snow trillium), and *Viola* (violet) spp., can be moderately abundant.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This hemlock - beech forest was sampled at six locations in the park. Sites are located on hills, moraines and lakeplains and range from flat to gently rolling terrain with some microtopography. Soils are moderately well- to well-drained sandy loam and loamy sand. The unvegetated surface is dominated by leaf litter (60-97% cover) with some wood (3-20%), bare soil (0-1%), dead plant stems (0-35%) and mosses (0-1%). Evidence of disturbance includes dead standing and windthrown trees and the presence of exotic plants.

Global Environment: This community is found primarily on dry-mesic to mesic loams and sands and sometimes on loamy silts (Kotar et al. 1988). Stands may be found on flat to moderately steep slopes of any aspect.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The dense (70-90% cover) tree canopy, 20-35+ m tall, is codominated by *Tsuga canadensis* (eastern hemlock) and *Fagus grandifolia* (American beech) and may include significant amounts of *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Betula papyrifera* (paper birch), *Populus grandidentata* (bigtooth aspen), and/or *Quercus rubra* (northern red oak). The sparse to dense (20-80%) subcanopy (10-20 m) is dominated by *Tsuga canadensis* (eastern hemlock) and may include other canopy species. The very sparse to moderate (<5-50%) tall-shrub layer (2-5 m) and very sparse (<5-20%) short-shrub layer (0.5-2 m) are made up of saplings of the canopy species; additional short shrubs may include *Diervilla lonicera* (northern bush honeysuckle), *Lonicera canadensis* (American fly honeysuckle), *Prunus virginiana* (chokecherry), *Taxus canadensis* (Canada yew), and *Viburnum acerifolium* (mapleleaf viburnum). The very sparse to moderate (5-4%) herbaceous layer is made up of tree seedings as well as *Epifagus virginiana* (beechdrops), *Maianthemum canadense* (Canada mayflower), *Mitchella repens* (partridgeberry), *Polygonatum pubescens* (hairy Solomon's seal), *Pteridium aquilinum* (western brackenfern), *Trientalis borealis* (starflower), and others.

Global Vegetation: The overstory is typically a closed canopy dominated by *Tsuga canadensis* (eastern hemlock) and either *Acer saccharum* (sugar maple) or *Fagus grandifolia* (American beech). *Betula alleghaniensis* (yellow birch), *Fraxinus americana* (white ash), and *Ulmus americana* (American elm) are common associates, and occasionally *Acer rubrum* (red maple), *Pinus strobus* (eastern white pine), and *Quercus rubra* (northern red oak) can be found in the canopy. Along with smaller individuals of the canopy species, *Abies balsamea* (balsam fir), *Ostrya virginiana* (hophornbeam), and *Picea glauca* (white spruce) can often be found in the undergrowth in Upper Michigan (Braun 1950). The shrub layer is usually not well-developed. *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Hamamelis virginiana* (American witch-hazel), and *Lonicera canadensis* (American fly honeysuckle) can be found scattered in this community. The herbaceous layer may contain few to many species. In some stands, the shade from the overstory and a carpet of *Acer saccharum* (sugar maple) seedlings do not allow other species to flourish (Braun 1950). In other places, herbaceous species such as *Anemone quinquefolia* (nightcaps), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Maianthemum canadense* (Canada mayflower), *Medeola virginiana* (Indian cucumber), *Maianthemum racemosum* (feathery false lily of the valley), *Trientalis borealis* (starflower), *Trillium grandiflorum* (snow trillium), and *Viola* (violet) spp. can be moderately abundant.

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MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Tsuga canadensis* (eastern hemlock)
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Fagus grandifolia* (American beech)
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
Tall shrub/sapling	Needle-leaved shrub	*Tsuga canadensis* (eastern hemlock)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Fagus grandifolia* (American beech), *Maianthemum canadense* (Canada mayflower), *Tsuga canadensis* (eastern hemlock)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Epipactis helleborine* (broadleaf helleborine, exotic, Medium/Low)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (22-Jun-1998).

CLASSIFICATION

Classification Confidence: 2 - Moderate

Global Comments: The type may be limited eastward by the main range of *Picea rubens* (red spruce), whose presence may indicate a transition to *Tsuga canadensis - (Betula alleghaniensis) - Picea rubens / Cornus canadensis* Forest (CEGL006129) in the region of the Ontario/Quebec border. Other more eastern species include *Acer pensylvanicum* (striped maple), *Viburnum lantanoides* (hobblebush), and *Trillium undulatum* (painted trillium) (Rogers 1980). The data by Rogers (1980), who examined pure hemlock stands (many of them less than 2 ha in size) from Wisconsin to Nova Scotia, make clear that there are few species strictly associated with a pure hemlock versus a mixed hemlock-hardwood type, and also indicate that some distinction between a Great Lakes versus northeastern United States/eastern Canada has some merit. Southward this type probably does not extend below Lake Erie or Lake Ontario, though stands in western New York need to be reviewed. Presence of some boreal species, such as *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), and *Cornus canadensis* (bunchberry dogwood) separate this type from *Tsuga canadensis - Fagus grandifolia - Acer saccharum / (Hamamelis virginiana, Kalmia latifolia)* Forest (CEGL005043) (Black and Mack 1976), but this needs further study. In Michigan this type is mostly on the lakeplain/outwash throughout the Michigan range of beech. Compare with *Tsuga canadensis - Acer saccharum - Betula alleghaniensis* Forest (CEGL005044).

Global Similar Associations:

- *Tsuga canadensis - (Betula alleghaniensis) - Picea rubens / Cornus canadensis* Forest (CEGL006129)
- *Tsuga canadensis - Acer saccharum - Betula alleghaniensis* Forest (CEGL005044)
- *Tsuga canadensis - Fagus grandifolia - Acer saccharum / (Hamamelis virginiana, Kalmia latifolia)* Forest (CEGL005043)
- *Tsuga canadensis - Fagus grandifolia - Quercus rubra* Forest (CEGL006088)

Global Related Concepts:

- *Acer - Fagus / Dryopteris* (Kotar et al. 1988) F
- *Acer - Tsuga / Dryopteris spinulosa* (Kotar et al. 1988) I
- Hardwood and Hemlock-Hardwood Forests (Braun 1950) B
- Mesic Northern Forest - Hemlock-Sugar Maple (Chapman et al. 1989) B

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along County Road 669, Schoolhouse Road, Good Harbor Bay Trail (east and west), and Old Indian Trail.

Global Range: This hemlock - beech hardwoods forest type is found in the central Great Lakes region of the United States and Canada, ranging from northeastern Wisconsin east to Michigan and southern Ontario.

Nations: CA, US

States/Provinces: MI, ON, WI:S4

USFS Ecoregions (1994/95): 212Hb:CCC, 212Hd:CCC, 212He:CCC, 212Hi:CCC, 212Hj:CCC, 212Hl:CCC, 212Hm:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCP, 212Hs:CCC, 212Ht:CCP, 212Hv:CCC, 212Hw:CCC, 212Hx:CCC, 212Ia:CCC, 212Jj:CCC, 212Jk:CC?, 212Jl:CCC, 212:Oa:CCC, 212Oc:CCC, 212Pa:CCC, 222Hb:CCC, 222Ia:CCC, 222Ja:CCC, 222Jj:CCC

Federal Lands: NPS (Pictured Rocks, Sleeping Bear Dunes); USFS (Chequamegon-Nicolet, Hiawatha, Huron, Huron-Manistee, Manistee?, Nicolet, Ottawa?)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.8, SLBE.10, SLBE.19, SLBE.27, SLBE.97, SLBE.99.

Sleeping Bear Dunes National Lakeshore Map Code: FHB

Local Description Authors: M.J. Russo

Global Description Authors: J. Drake

References: Black and Mack 1976, Braun 1950, Chapman et al. 1989, Farrand and Bell 1982, Kotar et al. 1988, Midwestern Ecology Working Group n.d., Rogers 1980, WNHIP unpubl. data

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1.C.3. Temperate Flooded & Swamp Forest

1.C.3.Na. Eastern North American Flooded & Swamp Forest

M030. Northern & Central Swamp Forest

G046. Northern & Central Conifer & Hardwood Alkaline Swamp Group

Red Maple - Ash - Birch Swamp Forest

***Acer rubrum* - *Fraxinus* spp. - *Betula papyrifera / Cornus canadensis* Forest**
Red Maple - Ash species - Paper Birch / Bunchberry Dogwood Forest
Identifier: CEGL002071

NVC CLASSIFICATION

Division	Eastern North American Flooded & Swamp Forest (1.C.3.Na)
Macrogroup	Northern & Central Swamp Forest (M030)
Group	Northern & Central Conifer & Hardwood Alkaline Swamp Group (G046)
Association (Common name)	Red Maple - Ash - Birch Swamp Forest
Ecological System(s):	Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575)

ELEMENT CONCEPT

Global Summary: This red maple swamp forest type is found in the northern parts of the Great Lakes region of the United States and in adjacent Canada. Stands are typically found on muck and shallow peat on lakeplains and floodplains. The canopy structure is variable, with cover ranging from open (25-60%) to closed (60-100%). Common canopy dominants include *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Betula papyrifera* (paper birch), *Fraxinus nigra* (black ash), *Fraxinus pennsylvanica* (green ash), and occasional *Larix laricina* (tamarack), *Pinus strobus* (eastern white pine), and *Ulmus americana* (American elm) (at least historically). *Pinus strobus* (eastern white pine) may form a patchy supercanopy above the hardwood canopy. Common shrubs include *Alnus incana* (gray alder). *Toxicodendron vernix* (poison-sumac) may be common in parts of the range. Other associates include *Ilex verticillata* (common winterberry), *Ribes* (currant) spp., and *Rubus idaeus* ssp. *strigosus* (grayleaf red raspberry). The herbaceous layer contains *Carex stipata* (owlfruit sedge), *Impatiens capensis* (jewelweed), *Mitella nuda* (naked miterwort), *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Osmunda claytoniana* (interrupted fern), *Saxifraga pensylvanica* (eastern swamp saxifrage), and others. A seepage swamp subtype can occur where steep sandy slopes and gravelly slopes merge with a river or stream terrace. The ground layer can be exceptionally diverse, with characteristic seepage species including *Angelica atropurpurea* (purplestem angelica), *Carex bromoides* (bromelike sedge), *Hydrocotyle americana* (American marshpennywort), *Poa paludigena* (bog bluegrass), *Saxifraga pensylvanica* (eastern swamp saxifrage), and *Symplocarpus foetidus* (skunk-cabbage).

ENVIRONMENTAL DESCRIPTION

Global Environment: Stands are typically found on muck and shallow peat on lakeplains and floodplains (MNNHP 1993).

VEGETATION DESCRIPTION

Global Vegetation: The canopy structure is variable, with cover ranging from open (25-60%) to closed (60-100%). Common canopy dominants include *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Betula papyrifera* (paper birch), *Fraxinus nigra* (black ash), *Fraxinus pennsylvanica* (green ash), and occasional *Larix laricina* (tamarack), *Pinus strobus* (eastern white pine), and *Ulmus americana* (American elm) (at least historically). *Pinus strobus* (eastern white pine) may form a patchy supercanopy above the hardwood canopy. Common shrubs include *Alnus incana* (gray alder), and *Toxicodendron vernix* (poison-sumac) may be common in parts of the range. Other associates include *Ilex verticillata* (common winterberry), *Ribes* (currant) spp., and *Rubus idaeus* ssp. *strigosus* (grayleaf red raspberry). The herbaceous layer contains *Carex stipata* (owlfruit sedge), *Impatiens capensis* (jewelweed), *Mitella nuda* (naked miterwort), *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Osmunda claytoniana* (interrupted fern), *Saxifraga pensylvanica* (eastern swamp saxifrage), and others (MNNHP 1993, Wovcha et al. 1995). A seepage swamp subtype can occur where steep sandy slopes and gravelly slopes merge with a river or stream terrace. The ground layer can be exceptionally diverse, with characteristic seepage species including *Angelica atropurpurea* (purplestem angelica), *Carex bromoides* (bromelike sedge), *Hydrocotyle americana* (American marshpennywort), *Poa paludigena* (bog bluegrass), *Saxifraga pensylvanica* (eastern swamp saxifrage), and *Symplocarpus foetidus* (skunk-cabbage) (MNNHP 1993, Wovcha et al. 1995).

OTHER NOTEWORTHY SPECIES

Global: Vulnerable: *Dryopteris crinalis* (serpent woodfern, G3), *Poa paludigena* (bog bluegrass, G3), *Rubus hispidoides* (bog dewberry, globally imperiled, G2?Q)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (3-Oct-1996). In Wisconsin, where the type is ranked S2, few high-quality occurrences have been documented (E. Epstein pers. comm. 1999).

CLASSIFICATION

Classification Confidence: 2 - Moderate

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Global Comments: Hydrology of this type may be a combination of seasonally flooded and saturated. This type can arise as a result of logging cedar swamps, or where hydrology has been altered (E. Epstein pers. comm. 1999). *Fraxinus nigra* (black ash) is less than 50% of the cover; if greater, then see the *Fraxinus nigra* (black ash) type (CEGL002105). If *Larix laricina* (tamarack) is at least 25% of the canopy, then see *Larix laricina - Acer rubrum / (Rhamnus alnifolia, Vaccinium corymbosum* (highbush blueberry)) Forest (CEGL005232) or *Larix laricina / Alnus incana* Forest (CEGL002471).

Global Similar Associations:

- *Fraxinus nigra* - Mixed Hardwoods - Conifers / *Cornus sericea / Carex* spp. Forest (CEGL002105)--This type is dominated by *Fraxinus nigra* and is more northern in distribution.
- *Larix laricina - Acer rubrum / (Rhamnus alnifolia, Vaccinium corymbosum)* Forest (CEGL005232)--This type contains significant *Larix laricina* (generally at least 25%, and more typically over 50% cover) and *Acer rubrum* (at least 25%). May overlap in concept.
- *Larix laricina / Alnus incana* Forest (CEGL002471)--This type is a rich swamp, with *Larix laricina* as the dominant (generally >50% cover).
- *Symplocarpus foetidus* Herbaceous Vegetation (CEGL002385)

Global Related Concepts:

- Southern Swamp (Chapman et al. 1989) B

ELEMENT DISTRIBUTION

Global Range: This red maple swamp forest type is found in the northern parts of the Great Lake states region of the United States and in adjacent Canada, ranging from Minnesota east to Michigan and Ontario.

Nations: CA, US

States/Provinces: MI, MN, ON, QC, WI:S2?

USFS Ecoregions (1994/95): 212He:CCP, 212Hl:CCP, 212Hm:CCP, 212Hn:CCP, 212Ho:CCP, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hu:CCP, 212Hv:CCC, 212Hw:CCP, 212Hx:CCP, 212Hy:CCP, 212Ia:CCC, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Jl:CPP, 212Jn:CPP, 212Jo:CPP, 212Kb:CCC, 212La:CPP, 212Mb:CPP, 212Na:CCP, 212Nb:CCP, 212Nc:CCC, 212:Oa:CCC, 222Jc:CCC, 222Jg:CCC, 222Mc:CCC, 222Md:CCC, 222Na:CCC

Federal Lands: NPS (Apostle Islands, Isle Royale, Saint Croix, Sleeping Bear Dunes); USFS (Chequamegon-Nicolet?, Chequamegon?, Chippewa, Huron-Manistee, Huron?, Manistee, Nicolet?, Ottawa)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: This association was not sampled with plots at Sleeping Bear Dunes NL.

Sleeping Bear Dunes National Lakeshore Map Code: FRM

Local Description Authors: NA

Global Description Authors: D. Faber-Langendoen

References: Chapman et al. 1989, Epstein pers. comm., MNNHP 1993, Midwestern Ecology Working Group n.d., WNHIP unpubl. data, Wovcha et al. 1995

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Black Ash - Mixed Hardwood Swamp

***Fraxinus nigra* - Mixed Hardwoods - Conifers / *Cornus sericea / Carex* spp. Forest**
Black Ash - Mixed Hardwoods - Conifers / Red-osier Dogwood / Sedge species Forest
Identifier: CEGL002105

NVC CLASSIFICATION

Division	Eastern North American Flooded & Swamp Forest (1.C.3.Na)
Macrogroup	Northern & Central Swamp Forest (M030)
Group	Northern & Central Conifer & Hardwood Alkaline Swamp Group (G046)
Association (Common name)	Black Ash - Mixed Hardwood Swamp
Ecological System(s):	Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575)
	Eastern Boreal Floodplain (CES103.588)

ELEMENT CONCEPT

Global Summary: This black ash - hardwood swamp forest is found widely in the northern midwestern region of the United States and into the boreal region of central Canada. Sites are found on well-decomposed woody peat or fine mineral soil. The type is found where perched wet pockets occur on fine sandy, clay loamy to fine loamy soils in valleys with impeded drainage or near shores. Hydrology can vary from seasonally flooded to saturated. Conditions are often transitional to uplands. Canopy structure is variable, ranging from 30-90% cover. The canopy is dominated by *Fraxinus nigra* (black ash) (at least 50% cover), with a diverse mix of hardwoods and conifers in the main and subcanopies, including *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Betula alleghaniensis* (yellow birch), *Fraxinus pennsylvanica* (green ash), *Picea glauca* (white spruce), *Populus balsamifera* (balsam poplar), *Populus tremuloides* (quaking aspen), *Thuja occidentalis* (northern white-cedar), *Tilia americana* (American basswood), and *Ulmus americana* (American elm). Shrub and sapling species include *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Cornus sericea* (red-osier dogwood), *Corylus cornuta* (beaked hazelnut), *Lonicera canadensis* (American fly honeysuckle), *Prunus virginiana* (chokecherry), *Ribes triste* (red currant), *Rubus idaeus* (American red raspberry), and *Rubus pubescens* (dwarf red blackberry). Herbaceous species include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Athyrium filix-femina* (common ladyfern), *Carex gracillima* (graceful sedge), *Carex intumescens* (greater bladder sedge), *Cinna latifolia* (drooping woodreed), *Circaea alpina* (small enchanter's nightshade), *Clintonia borealis* (bluebead), *Dryopteris carthusiana* (spinulose woodfern), *Equisetum sylvaticum* (woodland horsetail), *Fragaria virginiana* (Virginia strawberry), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), *Streptopus lanceolatus* var. *longipes* (twistedstalk), *Thalictrum pubescens* (king-of-the-meadow), and *Trientalis borealis* (starflower). Mosses include *Climacium dendroides* (tree climacium moss), *Plagiomnium* (plagiomnium moss) spp. A floodplain variant may also occur, with more hardwood dominance, with wetter species present, such as *Alnus incana* (gray alder), *Calamagrostis canadensis* (bluejoint), and *Caltha palustris* (yellow marsh-marigold). Diagnostic features include the dominance by *Fraxinus nigra* (black ash).

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This black ash - hardwood swamp forest was sampled at three locations in the park. Sites are located on intermittently flooded flat lakeplains with somewhat poorly drained clay loam or very poorly drained peat or muck soils. Conditions were dry at the time of sampling. The unvegetated surface is made up of leaf litter (25-65% cover), wood (7-30%), bare soil (0-5%), dead plant stems (3-40%) and mosses (20%). Evidence of disturbance includes dead standing and fallen trees and the presence of exotic plants.

Global Environment: Sites are found on well-decomposed woody peat or fine mineral soil. The type is found where perched wet pockets occur on fine sandy, clay loamy to fine loamy soils in valleys with impeded drainage or near shores. Hydrology can vary from seasonally flooded to saturated. Conditions are often transitional to uplands (Sims et al. 1989, MNNHP 1993, Cleland et al. 1994, Chambers et al. 1997).

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The sparse to dense (30-80% cover) tree canopy, 5-15 m tall, is dominated by *Fraxinus nigra* (black ash); additional species include *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Betula papyrifera* (paper birch), and/or *Fraxinus pennsylvanica* (green ash). The sparse to moderate (20-40%) subcanopy (10-15 m) may include canopy species as well as *Abies balsamea* (balsam fir), *Quercus rubra* (northern red oak), *Tilia americana* (American basswood), and *Ulmus americana* (American elm). The very sparse (5-10%) tall-shrub layer (2-5 m) and very sparse (5%) short-shrub layer (0.5-2 m) are made up of tree saplings; additional short shrubs include *Lonicera canadensis* (American fly honeysuckle), *Ribes cynosbati* (eastern prickly gooseberry), *Rubus idaeus* ssp. *strigosus* (grayleaf red raspberry), and *Rubus pubescens* (dwarf red blackberry). The moderate to very dense (60-90%) herbaceous layer is dominated by *Carex lacustris* (hairy sedge) (90% cover in one stand), along with lesser amounts of *Arisaema triphyllum* (Jack in the pulpit), *Athyrium filix-femina* (common ladyfern), *Galium tinctorium* (stiff marsh bedstraw), *Glyceria striata* (fowl mannagrass), *Impatiens capensis* (jewelweed), *Lycopus uniflorus* (northern bugleweed), *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Scirpus cyperinus* (woolgrass), *Symphyotrichum lateriflorum* (calico aster), *Thelypteris palustris* (eastern marsh fern), and others.

Global Vegetation: Canopy structure is variable, ranging from 30-90% cover. The canopy is dominated by *Fraxinus nigra* (black ash) (at least 50% cover), with a diverse mix of hardwoods and conifers in the main and sub canopies, including *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Betula alleghaniensis* (yellow birch), *Fraxinus pennsylvanica*

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(green ash), *Picea glauca* (white spruce), *Populus balsamifera* (balsam poplar), *Populus tremuloides* (quaking aspen), *Thuja occidentalis* (northern white-cedar), *Tilia americana* (American basswood), and *Ulmus americana* (American elm). Shrub and sapling species include *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Cornus sericea* (red-osier dogwood), *Corylus cornuta* (beaked hazelnut), *Lonicera canadensis* (American fly honeysuckle), *Prunus virginiana* (chokecherry), *Ribes triste* (red currant), *Rubus idaeus* (American red raspberry), and *Rubus pubescens* (dwarf red blackberry). Herbaceous species include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Athyrium filix-femina* (common ladyfern), *Carex gracillima* (graceful sedge), *Carex intumescens* (greater bladder sedge), *Cinna latifolia* (drooping woodreed), *Circaea alpina* (small enchanter's nightshade), *Clintonia borealis* (bluebead), *Dryopteris carthusiana* (spinulose woodfern), *Equisetum sylvaticum* (woodland horsetail), *Fragaria virginiana* (Virginia strawberry), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), *Streptopus lanceolatus* (twistedstalk), *Thalictrum pubescens* (king-of-the-meadow), and *Trientalis borealis* (starflower). Mosses include *Climacium dendroides* (tree climacium moss), *Plagiomnium* (plagiomnium moss) spp. (Sims et al. 1989, MNNHP 1993, Cleland et al. 1994, Harris et al. 1996, Chambers et al. 1997). A floodplain variant may also occur, with more hardwood dominance, with wetter species present, such as *Alnus incana* (gray alder), *Calamagrostis canadensis* (bluejoint), and *Caltha palustris* (yellow marsh-marigold) (Harris et al. 1996). Diagnostic features include the dominance by *Fraxinus nigra* (black ash).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Fraxinus nigra* (black ash)
Herb (field)	Graminoid	*Carex lacustris* (hairy sedge)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Carex lacustris* (hairy sedge), *Fraxinus nigra* (black ash), *Onoclea sensibilis* (sensitive fern)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Cirsium palustre* (marsh thistle, exotic, Medium/Low), *Epipactis helleborine* (broadleaf helleborine, exotic, Medium/Low), *Solanum dulcamara* (climbing nightshade, exotic, Low)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (3-Oct-1996).

CLASSIFICATION

Classification Confidence: 2 - Moderate

Global Comments: This type description is essentially boreal to sub-boreal in content, emphasizing the northern/western part of the range. Southern/eastern stands may differ and may warrant a separate type. For examples, see the description in Michigan provided by the Manistee National Forest FEC, ELTP 74 (Cleland et al. 1994), which lists *Hamamelis virginiana* (American witch-hazel), *Salix* (willow) spp. *Viburnum acerifolium* (mapleleaf viburnum), and *Viburnum nudum* var. *cassinoides* (withe-rod) in the shrub layer; and descriptions from central Minnesota (MNNHP 1993, Wovcha et al. 1995), which include virtually no conifers, lack a number of boreal species, and include others, such as the shrubs *Ilex verticillata* (common winterberry) and *Toxicodendron vernix* (poison-sumac), and the herbs *Arisaema triphyllum* (Jack in the pulpit), *Glyceria striata* (fowl mannagrass), *Impatiens capensis* (jewelweed), *Osmunda cinnamomea* (cinnamon fern), and *Onoclea sensibilis* (sensitive fern). A seepage variant has also been described in Minnesota, containing *Carex bromoides* (bromelike sedge) and *Symplocarpus foetidus* (skunk-cabbage). This seepage variant may resemble the riparian variant described in northern Ontario (MNNHP 1993, Harris et al. 1996 -W34). Finally, in Wisconsin stands have been described with a tree layer of *Fraxinus nigra* (black ash), *Tilia americana* (American basswood), *Picea glauca* (white spruce), a ground layer dominated by *Matteuccia struthiopteris* (ostrich fern) and *Laportea canadensis* (Canadian woodnettle), and a diverse mix of spring ephemerals that are more typical of southern Wisconsin (E. Epstein pers. comm. 1999).

Global Similar Associations:

- *Acer rubrum - Fraxinus* spp. - *Betula papyrifera / Cornus canadensis* Forest (CEGL002071)
- *Symplocarpus foetidus* Herbaceous Vegetation (CEGL002385)

Global Related Concepts:

- Black Ash Hardwood and Mixedwood (V2) (Sims et al. 1989) =
- Black Ash-Hardwoods-Herb Rich (V7) (Chambers et al. 1997) =
- ELTP 74 - Black ash-basswood-Viola plant association (Cleland et al. 1994) =
- Hardwood swamp: black ash (other hardwood): riparian (W34) (Harris et al. 1996) F
- Hardwood swamp: black ash (other hardwood): upland transition (W33) (Harris et al. 1996) F
- Northern Swamp (Chapman et al. 1989) B

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled on North Manitou Island (Lake Manitou) and North Bar Lake Nature Preserve.

Global Range: This black ash - hardwood swamp forest type is found widely in the northern midwestern region of the United States and into the boreal region of central Canada, ranging from northern Indiana and northern Illinois northward to Ontario and Manitoba.

Nations: CA, US

States/Provinces: IL, IN, MB:S2, MI, MN, ND:S3, ON, QC:S4?, WI:S3, WY

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USFS Ecoregions (1994/95): 212Ha:CCP, 212Hb:CCP, 212Hd:CCC, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCP, 212Hk:CCP, 212Hl:CCP, 212Hm:CCC, 212Hn:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hv:CCP, 212Hw:CCC, 212Hy:CCP, 212Ia:CCC, 212Ib:CCC, 212Ja:CCP, 212Jb:CCC, 212Jc:CCC, 212Jd:CCC, 212Je:CCP, 212Jf:CCP, 212Jj:CCP, 212Jk:CCP, 212Jl:CCP, 212Jm:CCC, 212Jn:CCP, 212Jo:CCP, 212Jr:CCP, 212Ka:CCC, 212Kb:CCC, 212La:CCC, 212Lb:CCC, 212Mb:CCC, 212Na:CCC, 212Nb:CCP, 212Nc:CCC, 212Oa:CCC, 222Ke:CCC, 222Kf:CCC, 222Kg:CCC, 222Lc:CCC, 222Ld:CCC, 222Lf:CCC, 222Mc:CCC, 222Md:CCC, 222Na:CCC, 251Aa:CCC, 251Dc:CCC
Federal Lands: NPS (Apostle Islands, Grand Portage, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron-Manistee, Manistee, Nicolet, Ottawa, Superior)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.42, SLBE.104, SLBE.105.
Sleeping Bear Dunes National Lakeshore Map Code: FBA
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Chambers et al. 1997, Chapman et al. 1989, Cleland et al. 1994, Greenall 1996, Harris et al. 1996, MNNHP 1993, Midwestern Ecology Working Group n.d., NDNHI unpubl. data, Sims et al. 1989, WNHIP unpubl. data, Wovcha et al. 1995

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Central Tamarack Poor Swamp

***Larix laricina / Photinia melanocarpa / Sphagnum* spp. Forest**
Tamarack / Black Chokeberry / Peatmoss species Forest
Identifier: CEGL002472

NVC CLASSIFICATION

Division	Eastern North American Flooded & Swamp Forest (1.C.3.Na)
Macrogroup	Northern & Central Swamp Forest (M030)
Group	Northern & Central Conifer & Hardwood Alkaline Swamp Group (G046)
Association (Common name)	Central Tamarack Poor Swamp
Ecological System(s):	North-Central Interior and Appalachian Acidic Peatland (CES202.606)
	High Allegheny Wetland (CES202.069)

ELEMENT CONCEPT

Global Summary: This community is found in the upper midwestern United States and adjacent Canada, with an outlier in the central Appalachian Mountains. Stands contain shallow peats in sites along rivers and in shallow lake basins, and may form a zone in a larger peatland site. The tree canopy is variable, with stands containing 25-100% cover. *Larix laricina* (tamarack) is either the sole dominant, or often mixed with *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Pinus strobus* (eastern white pine), *Fraxinus nigra* (black ash), and occasional *Picea mariana* (black spruce) in the west and *Nyssa sylvatica* (blackgum) in the east. The shrub layer may contain *Betula pumila* (bog birch) and *Chamaedaphne calyculata* (leatherleaf), as well as other more minerotrophic species, such as *Alnus incana* (gray alder), *Photinia melanocarpa* (black chokeberry), *Ilex verticillata* (common winterberry), *Toxicodendron vernix* (poison-sumac), *Vaccinium corymbosum* (highbush blueberry) (in the eastern part of its range), and *Rhododendron maximum* (great laurel) (in the Central Appalachians). The dwarf-shrub *Vaccinium macrocarpon* (cranberry) may also be present. The herbaceous layer contains a diverse mix of species, including *Carex lasiocarpa* (woollyfruit sedge), *Caltha palustris* (yellow marsh-marigold), *Coptis trifolia* (threeleaf goldthread), *Drosera rotundifolia* (roundleaf sundew), *Impatiens capensis* (jewelweed), *Osmunda cinnamomea* (cinnamon fern), *Sarracenia purpurea* (purple pitcherplant), and, in the Central Appalachians, *Symplocarpus foetidus* (skunk-cabbage). A nearly complete *Sphagnum* (sphagnum) spp. mat covers the ground. Diagnostic features may include dominance by *Larix laricina* (tamarack) and the presence of *Toxicodendron vernix* (poison-sumac).

ENVIRONMENTAL DESCRIPTION

Global Environment: Stands contain shallow peats in sites along poorly drained river systems and in shallow kettle lake basins, and may form a zone in a larger peatland site.

VEGETATION DESCRIPTION

Global Vegetation: The tree canopy is variable, with stands containing 25-100% cover. *Larix laricina* (tamarack) is either the sole dominant, or often mixed with *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Pinus strobus* (eastern white pine), *Fraxinus nigra* (black ash), and occasional *Picea mariana* (black spruce) in the west and *Nyssa sylvatica* (blackgum) in the east. The shrub layer may contain *Betula pumila* (bog birch) and *Chamaedaphne calyculata* (leatherleaf), as well as other more minerotrophic species, such as *Alnus incana* (gray alder), *Photinia melanocarpa* (black chokeberry), *Ilex verticillata* (common winterberry), *Toxicodendron vernix* (poison-sumac), *Vaccinium corymbosum* (highbush blueberry) (in the eastern part of its range), and *Rhododendron maximum* (great laurel) (in the Central Appalachians). The dwarf-shrub *Vaccinium macrocarpon* (cranberry) may also be present. The herbaceous layer contains a diverse mix of species, including *Carex lasiocarpa* (woollyfruit sedge), *Caltha palustris* (yellow marsh-marigold), *Coptis trifolia* (threeleaf goldthread), *Drosera rotundifolia* (roundleaf sundew), *Impatiens capensis* (jewelweed), *Osmunda cinnamomea* (cinnamon fern), *Sarracenia purpurea* (purple pitcherplant), and, in the Central Appalachians, *Symplocarpus foetidus* (skunk-cabbage). A nearly complete *Sphagnum* (sphagnum) spp. mat covers the ground (Brewer 1966, Catana 1967, Anderson 1982, MNNHP 1993, Byers et al. 2007).

CONSERVATION STATUS RANK

Global Rank & Reasons: G4? (3-Oct-1996).

CLASSIFICATION

Classification Confidence: 2 - Moderate
Global Comments: This type occurs south of the tension zone in the Great Lakes states and Ontario and has a few, isolated stands in Ohio and West Virginia. The more southern occurrences contain little or no *Picea mariana* (black spruce). *Toxicodendron vernix* (poison-sumac) may be typical, but it may not be very constant. Note also that the canopy can have a woodland character. Stands of this type are sometimes referred to as conifer bog "relicts," being south of the main distribution of conifer bogs following the most recent glaciation, but their origin may actually be more recent. Their classification needs additional study to determine whether a distinct type in the southeastern portion of the range is warranted. The absence of *Picea mariana* (black spruce) is a possible means to separate it from vegetation in the northern range.
Global Similar Associations:

- *Larix laricina - Acer rubrum / (Rhamnus alnifolia, Vaccinium corymbosum)* Forest (CEGL005232)--is a tamarack/minerotrophic type. In Ohio, it is distinguished by the presence of minerotrophic indicators, such as *Dasiphora fruticosa* ssp. *floribunda* and *Rhamnus alnifolia*, and the lack of more acid species, such as *Chamaedaphne calyculata*, and a continuous *Sphagnum* spp. layer.

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- *Larix laricina / Alnus incana* Forest (CEGL002471)--is similar northward, but has more boreal species, such as *Andromeda polifolia* var. *glaucophylla*.

Global Related Concepts:

- Southern Relict Conifer Swamp (tamarack) (Chapman et al. 1989) B
- Stand 7 (Catana 1967) ?
- Tamarack Forest (Brewer 1966) ?
- WV larch - sedge meadow (Robinette 1966) =

ELEMENT DISTRIBUTION

Global Range: This community is found in the midwestern United States and adjacent Canada, ranging from south-central Minnesota east to southern Ontario, with disjunct occurrences to the southeast in Ohio and West Virginia.
Nations: CA, US
States/Provinces: IL:S2, IN, MI, MN, OH, ON, QC, WI:S3, WV:S1
USFS Ecoregions (1994/95): 212Hb:CC?, 212Ht:CC?, 212Kb:CC?, 212Nc:CC? , 212:Oa:CCC, 221B:CC, 221Fa:CCC, 221Fc:CCC, 222Jb:CC?, 222Jc:CC?, 222Jd:CC?, 222Jg:CCC, 222Ji:CCC, 222Jj:CCC, 222Ka:CC?, 222Kb:CCC, 222Kd:CCC, 222Ke:CCC, 222Kf:CCC, 222Ma:CCC, 222Mb:CCC, 222Mc:CCC, 222Md:CCC, 222Na:CC?, M221Bb:CCC
Federal Lands: NPS (Indiana Dunes, Saint Croix, Sleeping Bear Dunes); USFS (Chippewa, Hiawatha)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: This association was not sampled with plots at Sleeping Bear Dunes NL.
Sleeping Bear Dunes National Lakeshore Map Code: FTS
Local Description Authors: NA
Global Description Authors: D. Faber-Langendoen, mod. E.A. Byers
References: Anderson 1982, Brewer 1966, Byers et al. 2007, Catana 1967, Chapman et al. 1989, MNNHP 1993, Midwestern Ecology Working Group n.d., Robinette 1966, WNHIP unpubl. data, White and Madany 1978

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White Pine - Red Maple Swamp

***Pinus strobus* - *(Acer rubrum)* / *Osmunda* spp. Forest**
Eastern White Pine - (Red Maple) / Royal Fern species Forest
Identifier: CEGL002482

NVC CLASSIFICATION

Division	Eastern North American Flooded & Swamp Forest (1.C.3.Na)
Macrogroup	Northern & Central Swamp Forest (M030)
Group	Northern & Central Conifer & Hardwood Alkaline Swamp Group (G046)
Association (Common name)	White Pine - Red Maple Swamp

ELEMENT CONCEPT

Global Summary: This white pine - red maple swamp forest is found in the southern Great Lakes region of the United States and Canada, ranging east in scattered locations. Stands occur on sites with at least a thin layer of organic material on the surface. Glacially deposited sand usually lies beneath the organic layer. The overstory is dominated by *Pinus strobus* (eastern white pine) and may contain *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Tsuga canadensis* (eastern hemlock), and *Ulmus americana* (American elm). Shrubs can be sparse but include *Alnus incana* (gray alder) and *Ilex verticillata* (common winterberry). Understory species include *Carex* (sedge) spp., *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis* (royal fern), and *Symplocarpus foetidus* (skunk-cabbage). *Sphagnum* (sphagnum) spp. may occur as a ground cover. In Wisconsin, common species include *Carex folliculata* (northern long sedge) and *Thelypteris simulata* (bog fern), which are more common in the eastern United States.

ENVIRONMENTAL DESCRIPTION

Global Environment: This community is flooded or saturated for at least part of the year. The soils have at least a thin layer of organic material on the surface, which may be thick enough to qualify as a soil layer itself. Glacially deposited sand usually lies beneath the organic layer, and these, in turn, are underlain, or interrupted by, impermeable silts and clays (E. Epstein pers. comm. 1999).

VEGETATION DESCRIPTION

Global Vegetation: The overstory is dominated by *Pinus strobus* (eastern white pine) and may contain *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Tsuga canadensis* (eastern hemlock), and *Ulmus americana* (American elm). Shrubs can be sparse, but include *Alnus incana* (gray alder) and *Ilex verticillata* (common winterberry). Understory species include *Carex* (sedge) spp., *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis* (royal fern) and *Symplocarpus foetidus* (skunk-cabbage). *Sphagnum* (sphagnum) spp. may occur as a ground cover. In Wisconsin, common species include *Carex folliculata* (northern long sedge) and *Thelypteris simulata* (bog fern), which are more common in the eastern United States (E. Epstein pers. comm. 1999).

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (22-Jun-1998). The total number of occurrences is unknown. One has been documented in Ohio (where the community is ranked S1), and 7 in Wisconsin (S2), where its distribution is very local on central Wisconsin glacial lake beds, with few good occurrences. Although no other occurrences have been documented, the community is also reported in Vermont (S?), Massachusetts (S?), Connecticut (S?), New York (S?), Ontario (S2), and possibly Minnesota (SP). It is usually found on a layer of organic soil over glacially deposited sand which is flooded or saturated for at least part of the year.

CLASSIFICATION

Classification Confidence: 2 - Moderate
Global Comments: See Golet et al. (1993 [p. 51]) for a description of this type in the northeastern United States. In Wisconsin, *Ilex verticillata* (common winterberry) and *Osmunda cinnamomea* (cinnamon fern) are typical. Elsewhere, *Osmunda regalis* (royal fern) may be more typical. In Michigan this type may be in Montcalm County. Status in Indiana is not clear.
Global Related Concepts:

- Hardwood-Conifer Swamp (Chapman et al. 1989) B
- Palustrine Broad-leaved Deciduous Forested Wetlands (PFO1) (Cowardin et al. 1979) ?
- Successional mixed forest (NAP pers. comm. 1998) ?

ELEMENT DISTRIBUTION

Global Range: This white pine - red maple swamp forest type is found in the southern Great Lakes region of the United States and Canada, ranging locally from central Wisconsin east to Ohio. It also occurs in scattered locations in the Northeast; it has been reported from two locations in Rhode Island and one potential occurrence in Pennsylvania. More data are needed to determine whether this type occurs more broadly in the Northeast.
Nations: CA, US
States/Provinces: MI, MN, OH:S1, ON, PA?, QC:S3?, RI, WI:S2
USFS Ecoregions (1994/95): 212Ec:CCC, 212Ha:CCP, 212Hb:CCP, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCP, 212Hk:CCP, 212Hl:CCP, 212Hm:CCP, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hv:CCP, 212Hx:CCP, 212Ja:CCP, 212Jb:CCP, 212Jc:CCP, 212Jh:CCC, 212Jk:CCP, 212Jl:CCP, 212Jn:CCP, 212Jo:CCP, 212Jr:CCP, 212:Oa:CCC, 221Ae:CPP, 221Da:CPP, 221Fa:CCC, 222Ka:CCC, 222Lb:CCC, M212D:CP, M212F:CP
Federal Lands: NPS (Pictured Rocks, Sleeping Bear Dunes); USFS (Huron, Huron-Manistee, Manistee, Ottawa)

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ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: This association was not sampled with plots at Sleeping Bear Dunes NL.
Sleeping Bear Dunes National Lakeshore Map Code: FWS
Local Description Authors: NA
Global Description Authors: J. Drake
References: Chapman et al. 1989, Cowardin et al. 1979, Epstein pers. comm., Golet et al. 1993, Midwestern Ecology Working Group n.d., NAP pers. comm. 1998, ONHD unpubl. data, WNHIP unpubl. data

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White-cedar - Black Ash Swamp

***Thuja occidentalis - Fraxinus nigra* Forest**
Northern White-cedar - Black Ash Forest
Identifier: CEGL005165

NVC CLASSIFICATION

Division	Eastern North American Flooded & Swamp Forest (1.C.3.Na)
Macrogroup	Northern & Central Swamp Forest (M030)
Group	Northern & Central Conifer & Hardwood Alkaline Swamp Group (G046)
Association (Common name)	White-cedar - Black Ash Swamp
Ecological System(s):	Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575)
	Great Lakes Wooded Dune and Swale (CES201.726)

ELEMENT CONCEPT

Global Summary: This northern white-cedar - black ash forest is found in the sub-boreal regions of the Great Lakes in the United States and Canada where it occurs on wet, saturated soils. Substrate is well-decomposed peat, and hummocky topography is present. Canopy cover is variable, sometimes fairly open. *Thuja occidentalis* (northern white-cedar) and *Fraxinus nigra* (black ash) dominate the canopy, but some stands may have *Fraxinus* (ash) in the upper canopy and *Thuja* (red cedar) in the lower canopy. *Thuja* (red cedar) tends to occur on the hummocks and *Fraxinus* (ash) in the hollows. *Populus tremuloides* (quaking aspen) can be a major component, but this may be caused by logging of *Thuja* (red cedar). *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), and *Picea glauca* (white spruce) may also be present. Shrubs include *Acer spicatum* (mountain maple), *Cornus alternifolia* (alternateleaf dogwood), *Lonicera canadensis* (American fly honeysuckle), *Ribes* (currant) spp., and *Rubus pubescens* (dwarf red blackberry). The herb layer includes *Aralia nudicaulis* (wild sarsaparilla), *Arisaema triphyllum* (Jack in the pulpit), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Tiarella cordifolia* (heartleaf foamflower) and *Trientalis borealis* (starflower).

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This northern white-cedar - black ash swamp forest was sampled twice in the park. The sites are saturated to seasonally flooded depressions with poorly drained silty clay loam or muck soils. The unvegetated surface is made up of leaf litter (5-47% cover), wood (10-50%), bare soil (0-1%), dead plant stems (2-5%) and mosses (0-80%). Evidence of disturbance includes dead standing and fallen trees and the presence of exotic plants.
Global Environment: Stands occur on wet, saturated soils. Substrate is either wet mineral soils or well-decomposed peat, and hummocky topography is present.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The sparse to moderately dense (30-70% cover) tree canopy, 10-15 m tall, is codominated by *Fraxinus nigra* (black ash) and *Thuja occidentalis* (northern white-cedar); additional species may include *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), and *Tsuga canadensis* (eastern hemlock). A subcanopy (10-15 m) may be lacking or sparse (0-30%) and include *Thuja occidentalis* (northern white-cedar) and *Tsuga canadensis* (eastern hemlock), as is the very sparse to sparse (<5-30%) tall-shrub layer (2-5 m). The moderate (60%) short-shrub layer (1-2 m) of one stand is comprised of *Abies balsamea* (balsam fir); additional short shrubs may include *Cornus sericea* (red-osier dogwood), *Lonicera canadensis* (American fly honeysuckle), and *Picea mariana* (black spruce). *Rubus hispidus* (bristly dewberry), *Rubus pubescens* (dwarf red blackberry), and/or *Vaccinium myrtilloides* (velvetleaf huckleberry) may form a very sparse (<5%) dwarf-shrub layer. The moderate to dense (60-80%) herbaceous layer may include *Arisaema triphyllum* (Jack in the pulpit), *Carex* (sedge) spp. (at total of 10 recorded in 2 sampled plots), *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), *Equisetum pratense* (meadow horsetail), *Fragaria vesca* (woodland strawberry), *Gaultheria hispidula* (creeping snowberry), *Glyceria striata* (fowl mannagrass), *Iris versicolor* (harlequin blueflag), *Maianthemum canadense* (Canada mayflower), *Maianthemum stellatum* (starry false lily of the valley), *Mitchella repens* (partridgeberry), *Pyrola elliptica* (waxflower shinleaf), *Ranunculus sceleratus* (cursed buttercup), *Stachys palustris* (marsh hedgenettle), *Symphyotrichum lateriflorum* (calico aster), *Trientalis borealis* (starflower), and others. Ferns include *Dryopteris carthusiana* (spinulose woodfern), *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis* (royal fern), and *Thelypteris palustris* (eastern marsh fern). Nonvascular species (sphagnum mosses) cover 80% of the ground surface in one stand.
Global Vegetation: Canopy cover is variable, sometimes fairly open. *Thuja occidentalis* (northern white-cedar) and *Fraxinus nigra* (black ash) dominate the canopy, but some stands may have *Fraxinus* (ash) in the upper canopy and *Thuja* (red cedar) in the lower canopy. *Thuja* (red cedar) tends to occur on the hummocks and *Fraxinus* (ash) in the hollows. *Populus tremuloides* (quaking aspen) can be a major component, but this may be caused by logging of *Thuja* (red cedar). *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), and *Picea glauca* (white spruce) may also be present. Shrubs include *Acer spicatum* (mountain maple), *Cornus alternifolia* (alternateleaf dogwood), *Lonicera canadensis* (American fly honeysuckle), *Ribes* (currant) spp., and *Rubus pubescens* (dwarf red blackberry). The herb rich layer includes *Aralia nudicaulis* (wild sarsaparilla), *Arisaema triphyllum* (Jack in the pulpit), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Galium*

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triflorum (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Tiarella cordifolia* (heartleaf foamflower), and *Trientalis borealis* (starflower) (Chambers et al. 1997).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Thuja occidentalis* (northern white-cedar)
Tree canopy	Broad-leaved deciduous tree	*Fraxinus nigra* (black ash)
Shrub/sapling (tall & short)	Needle-leaved shrub	*Abies balsamea* (balsam fir)
Herb (field)	Forb	*Coptis trifolia* (threeleaf goldthread)
Herb (field)	Fern or fern ally	*Equisetum pratense* (meadow horsetail)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Abies balsamea* (balsam fir), *Carex intumescens* (greater bladder sedge), *Coptis trifolia* (threeleaf goldthread), *Equisetum pratense* (meadow horsetail), *Fraxinus nigra* (black ash), *Gaultheria hispidula* (creeping snowberry), *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis* (royal fern), *Thuja occidentalis* (northern white-cedar)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Cirsium palustre* (marsh thistle, exotic, Medium/Low), *Rumex obtusifolius* (bitter dock, exotic), *Solanum dulcamara* (climbing nightshade, exotic, Low), *Taraxacum officinale* (common dandelion, exotic)

Global: Vulnerable: *Rubus hispidoides* (bog dewberry, globally imperiled, G2?Q)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (3-Oct-1996).

CLASSIFICATION

Classification Confidence: 3 - Weak

Global Comments: This type occurs on wet hummocky soils. Soils may be more minerotrophic than those found in pure northern white-cedar swamps. This type may better fit into a mixed conifer-hardwood category. Type may also be the same as *Thuja occidentalis - Acer rubrum / Cornus sericea* Forest (CEGL006199) or the White-cedar - (Mixed Conifer) / Alder Swamp, *Thuja occidentalis - (Picea mariana, Abies balsamea) / Alnus incana* Forest (CEGL002456). It may also be in Minnesota (Norm Aaseng). Distinctions at the association level are not clear, but will be reviewed as part of a Minnesota statewide analysis.

Global Similar Associations:

- *Thuja occidentalis - (Picea mariana, Abies balsamea) / Alnus incana* Forest (CEGL002456)--A pure evergreen cedar swamp type.
- *Thuja occidentalis - Acer rubrum / Cornus sericea* Forest (CEGL006199)--A more southerly distributed type.

Global Related Concepts:

- Hardwood-Conifer Swamp (Chapman et al. 1989) B
- White Cedar-Hardwoods-Fragrant Bedstraw-Herb Rich (V8) (Chambers et al. 1997) =

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along County Road 651 and at Otter Creek.

Global Range: This northern white-cedar - black ash swamp type is found in the northern Great Lakes region of the United States and Canada.

Nations: CA, US

States/Provinces: MI, MN, ON, WI

USFS Ecoregions (1994/95): 212Ha:CCP, 212Hb:CCP, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCC, 212Hk:CCP, 212Hl:CCC, 212Hm:CCC, 212Hn:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Hs:CCC, 212Ht:CCC, 212Hu:CCP, 212Hv:CCC, 212Hw:CCC, 212Ia:CCC, 212Ja:CCP, 212Jb:CCC, 212Jc:CCP, 212Jk:CCP, 212Jl:CCP, 212Jn:CCP, 212Jo:CCP, 212Jr:CCP, 212:Oa:CCC, 222If:CCC, 222Jc:CCC, 222Jg:CCC, 222Jh:CCC, 222Jj:CCC

Federal Lands: NPS (Apostle Islands, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Huron, Huron-Manistee, Ottawa, Superior?)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.13, SLBE.46.

Sleeping Bear Dunes National Lakeshore Map Code: FCA

Local Description Authors: M.J. Russo

Global Description Authors: D. Faber-Langendoen

References: Chambers et al. 1997, Chapman et al. 1989, Midwestern Ecology Working Group n.d.

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Hemlock - Yellow Birch Swamp Wet-Mesic Forest

***Tsuga canadensis* - *Betula alleghaniensis* Saturated Forest**
Eastern Hemlock - Yellow Birch Saturated Forest
Identifier: CEGL005003

NVC CLASSIFICATION

Division	Eastern North American Flooded & Swamp Forest (1.C.3.Na)
Macrogroup	Northern & Central Swamp Forest (M030)
Group	Northern & Central Conifer & Hardwood Alkaline Swamp Group (G046)
Association (Common name)	Hemlock - Yellow Birch Swamp Wet-Mesic Forest
Ecological System(s):	Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575)

ELEMENT CONCEPT

Global Summary: This community is found in the central Great Lakes region of the United States and adjacent Canada. Stands occur on wet-mesic areas with imperfectly drained sandy loam/loam or silty clay soils that are often saturated. These areas occur on gentle slopes, drainageways, and bordering lakes and wetlands. The nutrient status is generally poor to medium. The overstory of this community is composed of conifers with a moderate amount of deciduous trees. *Tsuga canadensis* (eastern hemlock) is usually the most abundant species with *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Betula alleghaniensis* (yellow birch), *Pinus strobus* (eastern white pine), and *Thuja occidentalis* (northern white-cedar) less common. *Abies balsamea* (balsam fir) in northern Wisconsin and Michigan. The shrub layer is not well-developed in mature stands with dense canopies, but shrubs are often abundant in disturbed or young stands. Shrubs that may be present include *Amelanchier* (serviceberry) spp., *Corylus cornuta* (beaked hazelnut), *Lonicera canadensis* (American fly honeysuckle), *Prunus pensylvanica* (pin cherry), and *Vaccinium* (blueberry) spp. Common herbaceous species include *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (starflower), *Viola* (violet) spp., and others.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This eastern hemlock wetland forest was sampled once in the park at Glen Lake. The site is a semipermanently flooded lake terrace (toeslope) with very poorly drained muck soil. The unvegetated surface is made up of leaf litter (3% cover), large rocks (1%), wood (10%), dead plant stems (30%), bare soil (5%), standing water to 0.1 m deep (15%) and mosses (36%). Evidence of disturbance includes heavy deer browse, windthrown trees and the presence of exotic plants.
Global Environment: This community is typically found on wet-mesic areas with imperfectly drained loamy sand, sandy loam, and loam soils that are often saturated. These areas occur on gentle slopes, drainageways, and bordering lakes and wetlands. The nutrient status is generally poor to medium (Kotar et al. 1988).

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The moderate (50% cover) tree canopy, 5-10 m tall, is dominated by *Tsuga canadensis* (eastern hemlock) and contains lesser amounts of *Fraxinus americana* (white ash) and *Thuja occidentalis* (northern white-cedar). The very sparse (5%) tall-shrub layer (2-5 m) and very sparse (5%) short-shrub layer (0.5-1 m) are made up of sapling canopy species. The moderately dense (70%) herbaceous layer is dominated by *Impatiens capensis* (jewelweed) and includes small amounts of *Actaea pachypoda* (white baneberry), *Aralia nudicaulis* (wild sarsaparilla), *Arisaema triphyllum* (Jack in the pulpit), *Carex crinita* (fringed sedge), *Carex eburnea* (bristleleaf sedge), *Circaea alpina* (small enchanter's nightshade), *Equisetum fluviatile* (water horsetail), *Equisetum sylvaticum* (woodland horsetail), *Rorippa nasturtium-aquaticum* (watercress), and *Sphenopholis intermedia* (slender wedgescale). Nonvascular species (mostly sphagnum mosses) cover 50% of the ground surface. This community also supports the only known park population of Federally listed endangered and critically imperiled *Mimulus glabratus* var. *michiganensis* (Michigan monkeyflower).
Global Vegetation: The overstory of this community is composed of conifers with a moderate amount of deciduous trees. *Tsuga canadensis* (eastern hemlock) is usually the most abundant species with *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Betula alleghaniensis* (yellow birch), *Picea glauca* (white spruce), *Pinus strobus* (eastern white pine), and *Thuja occidentalis* (northern white-cedar) less common. The shrub layer is not well-developed in mature stands with dense canopies, but shrubs are often abundant in disturbed or young stands. Shrubs that may be present include *Amelanchier* (serviceberry) spp., *Corylus cornuta* (beaked hazelnut), *Lonicera canadensis* (American fly honeysuckle), *Prunus pensylvanica* (pin cherry), and *Vaccinium* (blueberry) spp. Common herbaceous species include *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Maianthemum canadense* (Canada mayflower), *Oxalis montana* (mountain woodsorrel), *Trientalis borealis* (starflower), *Viola* (violet) spp., and others.

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Tsuga canadensis* (eastern hemlock)
Herb (field)	Forb	*Impatiens capensis* (jewelweed)

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CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Impatiens capensis* (jewelweed), *Tsuga canadensis* (eastern hemlock)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Epilobium parviflorum* (smallflower hairy willowherb, exotic), *Epipactis helleborine* (broadleaf helleborine, exotic, Medium/Low), *Myosotis scorpioides* (true forget-me-not, exotic); **Other**: *Mimulus glabratus* var. *michiganensis* (Michigan monkeyflower, Federally listed endangered, G5T1)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (22-Jun-1998). This type is fairly widespread in, e.g., Wisconsin, but few good occurrences have been recorded (E. Epstein pers. comm. 1999).

CLASSIFICATION

Classification Confidence: 3 - Weak

Global Comments: Type probably varies from mixed evergreen-deciduous to evergreen, with at least 25% *Tsuga canadensis* (eastern hemlock) present (cover or basal area), and the rest either hardwoods or some conifers. If *Thuja occidentalis* (northern white-cedar) is prominent (>50% cover (or basal area?) of the conifer component?), place with *Thuja occidentalis* (northern white-cedar) northern white-cedar types, such as *Thuja occidentalis - (Picea mariana, Abies balsamea) / Alnus incana* Forest (CEGL002456). Mixed stands of *Thuja* (red cedar) and *Tsuga* (hemlock) have been identified on the Chequamegon National Forest in Wisconsin, and are currently placed with this *Tsuga* (hemlock) type until field verification can be conducted (M. Brzeskiewicz pers. comm. 1997). Type may equal *Tsuga canadensis - Betula alleghaniensis / Ilex verticillata / Sphagnum* spp. Forest (CEGL006226) in the Northeast, but would make a broad type. Stands in northeastern Ohio are placed with CEGL006226, found in New York and the northeastern United States. Ohio stands have no *Rhododendron* (rhododendron) spp. (at least, not currently), and appear to resemble CEGL006226 more than CEGL006279. In Michigan this type is found in Gogebic and Iron counties in the western Upper Peninsula.

Global Similar Associations:

- *Thuja occidentalis - (Picea mariana, Abies balsamea) / Alnus incana* Forest (CEGL002456)
- *Tsuga canadensis - Betula alleghaniensis / Ilex verticillata / Sphagnum* spp. Forest (CEGL006226)
- *Tsuga canadensis / Rhododendron maximum / Sphagnum* spp. Forest (CEGL006279)

Global Related Concepts:

- *Tsuga / Maianthemum - Coptis* (Kotar et al. 1988) =
- Rich Conifer Swamp (Chapman et al. 1989) ?

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Glen Lake (South Shore Unit).

Global Range: This community is found in the central Great Lakes region of the United States and adjacent Canada, ranging from northern Wisconsin to southern Ontario.

Nations: CA, US

States/Provinces: MI, OH, ON:S3S4, WI:S2S4

USFS Ecoregions (1994/95): 212Ha:CCC, 212Hb:CCP, 212Hh:CCP, 212Hi:CCC, 212Hl:CCP, 212Hm:CCP, 212Ho:CCC, 212Hr:CCP, 212Ht:CCP, 212Hu:CCP, 212Hv:CC?, 212Hw:CCC, 212Ia:CCC, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Jf:CPP, 212Jl:CPP, 212Jm:CPP, 212Jn:CPP, 212Jo:CPP, 212:Oa:CCC, 222Ia:CCC, 222Ja:CCC

Federal Lands: NPS (Apostle Islands, Pictured Rocks, Sleeping Bear Dunes); USFS (Chequamegon, Chequamegon-Nicolet, Hiawatha?, Huron-Manistee, Huron?, Manistee, Nicolet, Ottawa)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.68.

Sleeping Bear Dunes National Lakeshore Map Code: FHS

Local Description Authors: M.J. Russo

Global Description Authors: J. Drake

References: Chapman et al. 1989, Epstein pers. comm., Kotar et al. 1988, Midwestern Ecology Working Group n.d., WNHIP unpubl. data

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M160. Northern & Central Tall Shrub Wetland

G167. Northern & Central Shrub Swamp Group

Gray Alder Swamp

***Alnus incana* Swamp Shrubland**
Gray Alder Swamp Shrubland
Identifier: CEGL002381

NVC CLASSIFICATION

Division	Eastern North American Flooded & Swamp Forest (1.C.3.Na)
Macrogroup	Northern & Central Tall Shrub Wetland (M160)
Group	Northern & Central Shrub Swamp Group (G167)
Association (Common name)	Gray Alder Swamp
Ecological System(s):	Western Great Plains Open Freshwater Depression Wetland (CES303.675)
	Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582)
	High Allegheny Wetland (CES202.069)

ELEMENT CONCEPT

Global Summary: This alder swamp community is widespread in the midwestern and northeastern United States and southern Canada. Stands occur on shores, edges of beaver meadows in stream floodplains, swales associated with small streams in peatlands, or upland forests. Soils are well-decomposed peat, muck or mineral soils. The hydrology is typically seasonally flooded, with most sites remaining saturated. The vegetation is dominated by tall shrubs, 2-8 m in height, with a moderately open to dense shrub canopy. There is an understory of shorter shrubs and herbaceous species. The density of the understory varies inversely with the tall-shrub canopy. The overstory is usually overwhelmingly dominated by *Alnus incana* (gray alder), but in the more southeastern portions of this type's range, *Alnus serrulata* (hazel alder) can occur with *Alnus incana* (gray alder). Where alder is not as dominant, other shrubs, such as *Cornus sericea* (red-osier dogwood), *Ilex verticillata* (common winterberry), *Rubus idaeus* (American red raspberry), *Salix* (willow) spp., *Spiraea alba* (white meadowsweet), *Spiraea tomentosa* (steeplebush), and *Viburnum* (viburnum) spp., can be found. At the southern range limit of this type in West Virginia, shrub layers may by be dominated or codominated by the Central Appalachian endemic *Ilex collina* (longstalk holly). The herbaceous layer contains species such as *Symphyotrichum lanceolatum* var. *lanceolatum* (white panicle aster), *Symphyotrichum puniceum* (purplestem aster), *Calamagrostis canadensis* (bluejoint), *Caltha palustris* (yellow marsh-marigold), *Carex lacustris* (hairy sedge), *Carex prairea* (prairie sedge), *Carex trisperma* (threeseeded sedge), *Doellingeria umbellata* (parasol whitetop), *Eupatorium maculatum* (spotted joepyeweed), *Glyceria melicaria* (melic mannagrass), *Glyceria striata* (fowl mannagrass), *Impatiens capensis* (jewelweed), *Lycopus uniflorus* (northern bugleweed), *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Rubus pubescens* (dwarf red blackberry), *Scirpus atrovirens* (green bulrush), *Symplocarpus foetidus* (skunk-cabbage), *Thelypteris palustris* (eastern marsh fern), *Typha* (cattail) spp., and *Viola* (violet) spp. Mosses include *Climacium dendroides* (tree climacium moss) and *Sphagnum* (sphagnum) spp. Where the tall-shrub canopy is open, graminoids can become dense. Scattered trees are found in many stands, including *Acer rubrum* (red maple), *Fraxinus nigra* (black ash), and *Thuja occidentalis* (northern white-cedar).

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This alder swamp community was sampled twice in the park. The sites are a flat saturated floodplain and a depression with poorly drained clay or muck soil. The unvegetated surface is made up of leaf litter (40-55% cover), bare soil (10-15%), dead plant stems (25-35%), mosses (0-10%) and standing water (0-10%). One stand is located in the site of an old sawmill from the late 1800s. Other disturbances include evidence of beaver activity and the presence of exotic plants.
Global Environment: Sites are typically along streams, lakeshores, edges of beaver meadows, swales associated with small streams in peatlands or upland forests, or near seeps. Most have little to no slope, but some sites are on moderate slopes. Hydrologic conditions can range from temporarily flooded to seasonally flooded, or even saturated, but are typically seasonally flooded/saturated. The water ranges from non-stagnant, nutrient-rich, and often slightly calcareous (Curtis 1959) to rather stagnant and nutrient-poor where over acidic bedrock or till. Soils are wet, often mucks or peats (Anderson 1982, Chapman et al. 1989). In the upper Midwest, this community is found on Precambrian Shield bedrock that is overlaid with sandy loam soils, which are moderately well-drained and deep (>60 cm). In northeastern Minnesota stands can occur on northeast- and south-facing slopes that are moderate to steep, with slopes ranging from 4 to 45% (Ohmann and Ream 1971). The climate is highly variable, with temperature extremes between -46 and 38 degrees C and 58-91 cm precipitation.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The dense (80-90%) tall-shrub layer (2-5 m) is dominated by *Alnus incana* ssp. *rugosa* (speckled alder); additional species may include *Cornus amomum* (silky dogwood), *Cornus sericea* (red-osier dogwood), *Ilex verticillata* (common winterberry), *Rosa palustris* (swamp rose), and *Salix discolor* (pussy willow). A short-shrub layer (1-2 m) may be lacking or dense (80%) and also dominated by *Alnus incana* ssp. *rugosa* (speckled alder). *Rubus pubescens* (dwarf red blackberry) and *Vaccinium myrtilloides* (velvetleaf huckleberry) may form a very sparse (5%) dwarf-shrub layer. The moderate to dense (60-80%) herbaceous layer may include by *Asclepias incarnata* (swamp milkweed), *Calamagrostis canadensis* (bluejoint), *Carex* (sedge) spp. (*Carex aquatilis* (water sedge) has 80% cover in one stand), *Cicuta bulbifera* (bulblet-bearing water hemlock),

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Coptis trifolia (threeleaf goldthread), *Dryopteris carthusiana* (spinulose woodfern), *Eupatorium maculatum* (spotted joepyeweed), *Eupatorium perfoliatum* (common boneset), *Galium tinctorium* (stiff marsh bedstraw), *Glyceria striata* (fowl mannagrass), *Lycopus uniflorus* (northern bugleweed), *Lysimachia thyrsiflora* (tufted loosestrife), *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis* (royal fern), *Parthenocissus quinquefolia* (Virginia creeper), *Scirpus atrovirens* (green bulrush), *Scirpus cyperinus* (woolgrass), *Solidago canadensis* (Canada goldenrod), *Symphyotrichum lanceolatum* (white panicle aster), *Symphyotrichum lateriflorum* (calico aster), *Thelypteris palustris* (eastern marsh fern), *Triadenum fraseri* (Fraser's marsh St. Johnswort), *Trientalis borealis* (starflower), and others. Nonvascular species (mosses) cover 10% of the ground surface.

Global Vegetation: The vegetation is dominated by tall shrubs, 2-8 m in height, with a moderately open to dense shrub canopy. There is an understory of shorter shrubs and herbaceous species. The density of the understory varies inversely with the tall-shrub canopy. The overstory is usually overwhelmingly dominated by *Alnus incana* (gray alder), but in the more southeastern portions of this type's range, *Alnus serrulata* (hazel alder) can occur with *Alnus incana* (gray alder). Where alder is not as dominant, other shrubs, such as *Cornus sericea* (red-osier dogwood), *Ilex verticillata* (common winterberry), *Rubus idaeus* (American red raspberry), *Salix* (willow) spp., *Spiraea alba* (white meadowsweet), *Spiraea tomentosa* (steeplebush), and *Viburnum* (viburnum) spp., can be found. The herbaceous layer contains species such as *Symphyotrichum lanceolatum* var. *lanceolatum* (white panicle aster), *Symphyotrichum puniceum* (purplestem aster), *Calamagrostis canadensis* (bluejoint), *Caltha palustris* (yellow marsh-marigold), *Carex lacustris* (hairy sedge), *Carex prairea* (prairie sedge), *Carex trisperma* (threeseeded sedge), *Doellingeria umbellata* (parasol whitetop), *Eupatorium maculatum* (spotted joepyeweed), *Impatiens capensis* (jewelweed), *Lycopus uniflorus* (northern bugleweed), *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Rubus pubescens* (dwarf red blackberry), *Scirpus atrovirens* (green bulrush), *Symplocarpus foetidus* (skunk-cabbage), *Thelypteris palustris* (eastern marsh fern), *Typha* (cattail) spp., and *Viola* (violet) spp. Mosses include *Climacium dendroides* (tree climacium moss) and *Sphagnum* (sphagnum) spp. Where the tall-shrub canopy is open, the graminoids can become dense. Scattered trees are found in many stands, including *Acer rubrum* (red maple), *Fraxinus nigra* (black ash), and *Thuja occidentalis* (northern white-cedar) (Curtis 1959, Anderson 1982, MNNHP 1993, Harris et al. 1996, Sperduto 2000b, Thompson and Sorenson 2000, Gawler 2002). Where stands border on saturated conditions with peaty soils, peatland species such as *Chamaedaphne calyculata* (leatherleaf), *Rhododendron canadense* (rhodora), and *Sphagnum* (sphagnum) spp. may be present.

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Alnus incana* ssp. *rugosa* (speckled alder)
Herb (field)	Graminoid	*Carex aquatilis* (water sedge)

Global

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Alnus incana* (gray alder)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Alnus incana* ssp. *rugosa* (speckled alder), *Calamagrostis canadensis* (bluejoint), *Carex aquatilis* (water sedge), *Osmunda cinnamomea* (cinnamon fern)
Global: *Alnus incana* (gray alder)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Solanum dulcamara* (climbing nightshade, exotic, Low)
Global: Vulnerable: *Ilex collina* (longstalk holly, vulnerable, G3)

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Jun-2006). This association is widely distributed and considered secure in many states.

CLASSIFICATION

Classification Confidence: 2 - Moderate

Global Comments: Type has a very broad distribution, and there may be a need to separate a northern (more boreal) type from a southern (more temperate) type, or perhaps an enriched versus lower-nutrient type, based on floristic differences. Hydrology may be quite variable, ranging from temporarily flooded to semipermanently flooded. In Ohio, this association sometimes merges with *Alnus serrulata* (hazel alder) stands in *Alnus serrulata* Swamp Shrubland (CEGL005082); that association is distinguished by somewhat more southern associates, including *Rhododendron viscosum* (swamp azalea), *Lindera benzoin* (northern spicebush), *Peltandra virginica* (green arrow-arum), etc.. With increasing tree canopy cover, this association can be similar to *Larix laricina* (tamarack) forest types, *Thuja occidentalis* (northern white-cedar) saturated forest types, and *Fraxinus nigra - Acer rubrum* saturated forest types.

Global Similar Associations:
- *Alnus incana - Cornus (amomum, sericea) / Clematis virginiana* Shrubland (CEGL006062)
- *Alnus incana* ssp. *rugosa - Nemopanthus mucronatus / Sphagnum* spp. Shrubland (CEGL006158)
- *Alnus serrulata* Swamp Shrubland (CEGL005082)

Global Related Concepts:
- *Alnus incana - Sambucus canadensis* shrub community (Darlington 1943) F
- *Alnus incana - Viburnum cassinoides* shrub community (Darlington 1943) F
- *Alnus incana* ssp. *rugosa* tall shrub thicket (Fortney et al. 2005) =
- *Alnus rugosa* shrub (Walbridge and Lang 1982) =

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- *Alnus rugosa* tall shrub community (Walbridge 1982) =
- *Alnus rugosa* tall shrub community (Robinette 1966) =
- *Alnus rugosa* thicket community (Fortney 1975) =
- Alder Shrub Swamp (Anderson and Schwegman 1991) =
- Alder Shrub Thicket (Gawler 2002) B
- Alder Thicket (Curtis 1959) =
- Thicket Swamp: Speckled Alder / Bluejoint Grass type , W35 (Harris et al. 1996) =

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Boekaloo Road and Otter Creek at Esch Road.

Global Range: This alder swamp shrubland is widespread in the midwestern and northeastern United States and southern Canada, ranging from Maine west to Manitoba, south to Iowa, and east to New York and perhaps northern New Jersey.

Nations: CA, US

States/Provinces: IA:S3?, IL, IN?, MA, MB?, ME, MI:S5, MN:S5, ND:S2?, NH:S3S4, NJ?:S2S4, NY, OH, ON, PA, QC:S4S5, VT, WI:S4, WV:S3, WY

USFS Ecoregions (1994/95): 212Cb:CCC, 212Da:CCC, 212Db:CCC, 212Dc:CCC, 212Fc:CCC, 212Ha:CCP, 212Hb:CCP, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCP, 212Hk:CCP, 212Hl:CCC, 212Hm:CCP, 212Hn:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCC, 212Hr:CCP, 212Hs:CCP, 212Ht:CCC, 212Hv:CCP, 212Hw:CCC, 212Hy:CCP, 212Ia:CCC, 212Ib:CCC, 212Ja:CCP, 212Jb:CCP, 212Jc:CCP, 212Je:CCP, 212Jf:CCC, 212Jj:CCP, 212Jk:CCP, 212Jl:CCP, 212Jm:CCP, 212Jn:CCP, 212Jo:CCP, 212Jr:CCC, 212Ka:CCP, 212Kb:CCC, 212La:CCC, 212Lb:CCC, 212Mb:CPP, 212Na:CCC, 212Nb:CCP, 212Nc:CCC, 212:Oa:CCC, 221Ae:CCC, 221Ak:CCP, 221Al:CCP, 221Bc:CCC, 222Je:CCC, 222Lb:CCC, 222Lc:CCC, 222Mc:CCC, 222Md:CCC, 222Na:CCC, 251Aa:CCC, 251Ab:CCC, M212Aa:CCC, M212Ac:CCC, M212Ae:CCC, M212Af:CCC, M212B:CC, M212C:CC, M212D:CP

Federal Lands: NPS (Acadia, Apostle Islands, Appalachian Trail, Grand Portage, Isle Royale, Pictured Rocks, Saint Croix, Saratoga, Sleeping Bear Dunes, Upper Delaware, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa, Superior); USFWS (Aroostook, Assabet River, Carlton Pond, Moosehorn?, Nulhegan Basin)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.33, SLBE.79.

Sleeping Bear Dunes National Lakeshore Map Code: SAS

Local Description Authors: M.J. Russo

Global Description Authors: D. Faber-Langendoen, mod. S.C. Gawler

References: Anderson 1982, Anderson and Schwegman 1991, Breden et al. 2001, Byers et al. 2007, Chapman et al. 1989, Curtis 1959, Darlington 1943, DeMeo et al. 1998, Fortney 1975, Fortney et al. 2005, Gawler 2002, Greenall 1996, Harris et al. 1996, INAI unpubl. data, MNNHP 1993, Midwestern Ecology Working Group n.d., NDNHI unpubl. data, NRCS 2004a, Ohmann and Ream 1971, Rentch unpubl. data 2003, Robinette 1966, Sperduto 2000b, Swain and Kearsley 2001, Thompson and Sorenson 2000, WNHIP unpubl. data, Walbridge 1982, Walbridge and Lang 1982

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1.D.1. Lowland & Montane Boreal Forest

1.D.1.Na. North American Boreal Forest

M037. Eastern & Central North American Boreal Conifer & Hardwood Forest

G047. Jack Pine - Black Spruce Forest Group

Jack Pine / Blueberry / Feathermoss Forest

***Pinus banksiana* / *Vaccinium* spp. / *Pleurozium schreberi* Forest**

Jack Pine / Blueberry species / Feathermoss Forest

Identifier: CEGL002441

NVC CLASSIFICATION

Division	North American Boreal Forest (1.D.1.Na)
Macrogroup	Eastern & Central North American Boreal Conifer & Hardwood Forest (M037)
Group	Jack Pine - Black Spruce Forest Group (G047)
Association (Common name)	Jack Pine / Blueberry / Feathermoss Forest
Ecological System(s):	Boreal Jack Pine-Black Spruce Forest (CES103.022)
	Laurentian Pine-Oak Barrens (CES201.718)
	Boreal Dry Jack Pine Woodland (CES103.499)

ELEMENT CONCEPT

Global Summary: This jack pine forest is found in the northern parts of the midwestern United States and in central Canada, with disjunct occurrences in the far northeastern United States. Sites occupy flat to rolling topography. The soils are sandy loams, fine sands, and loamy sands, shallow to deep, and with low organic content. The overstory of this forest community is largely made up of moderately to densely spaced conifers with a scattering of deciduous trees. The trees in this community are typically 15-20 m tall. *Pinus banksiana* (jack pine) is often the only tree of significance in the overstory. In some stands, smaller amounts of *Betula papyrifera* (paper birch), *Picea mariana* (black spruce), *Pinus resinosa* (red pine), and *Populus tremuloides* (quaking aspen) may be found. Tall shrubs are uncommon, but may occur in patches. The most common of these are *Alnus viridis* (green alder) and *Amelanchier alnifolia* (Saskatoon serviceberry). In the Midwest, occasional grubs of *Quercus ellipsoidalis* (northern pin oak) and *Quercus macrocarpa* (bur oak) may be present. Low shrubs are abundant. These include *Arctostaphylos uva-ursi* (kinnikinnick), *Diervilla lonicera* (northern bush honeysuckle), *Juniperus communis* (common juniper), *Linnaea borealis* (twinflower), *Rosa acicularis* (prickly rose), and *Vaccinium* (blueberry) spp. The herbaceous layer contains many species typical of northern coniferous forests, such as *Aralia nudicaulis* (wild sarsaparilla), *Anemone quinquefolia* (nightcaps), *Cornus canadensis* (bunchberry dogwood), *Fragaria virginiana* (Virginia strawberry), *Maianthemum canadense* (Canada mayflower), and *Trientalis borealis* (starflower). Mosses, especially *Pleurozium schreberi* (Schreber's big red stem moss), form a nearly continuous carpet.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This jack pine forest was sampled once in the park. The site is flat with some rolling microtopography with well-drained sandy loam soil. The unvegetated surface is dominated by leaf litter (90% cover) with some wood (5%) and dead plant stems (5%). Evidence of disturbance includes dead standing and fallen trees and the presence of exotic plants.

Global Environment: This community is found on flat to rolling topography, such as glaciofluvial and lacustrine deposits, moraines, and other glacial features. The soils are sandy loams, fine sands, and loamy sands, shallow to deep, and with low organic content (Sims et al. 1989, MNNHP 1993). In Wisconsin, stands are found on the "sandscapes" of the Apostle Islands (E. Epstein pers. comm. 1999, NatureServe unpubl. data 2005).

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The sparse (30% cover) tree canopy, 15-20 m tall, is dominated by *Pinus banksiana* (jack pine) and includes small amounts of *Populus grandidentata* (bigtooth aspen) and *Quercus rubra* (northern red oak). The subcanopy and shrub layers are negligible. *Gaylussacia baccata* (black huckleberry) and *Vaccinium angustifolium* (lowbush blueberry) form a moderately dense (60%) dwarf-shrub layer. The moderate (40%) herbaceous layer is dominated by *Pteridium aquilinum* (western brackenfern) and includes small amounts of *Epigaea repens* (trailing arbutus), *Gaultheria procumbens* (eastern teaberry), and *Gaultheria procumbens* (eastern teaberry).

Global Vegetation: The overstory of this forest community is dominated by moderately to densely spaced conifers with a scattering of deciduous trees. The trees in this community are typically 15-20 m tall (Mueller-Dombois 1964). *Pinus banksiana* (jack pine) is often the only tree of significance in the overstory (Mueller-Dombois 1964, MNNHP 1993). In some stands, smaller amounts of *Betula papyrifera* (paper birch), *Picea mariana* (black spruce), *Pinus resinosa* (red pine), and *Populus tremuloides* (quaking aspen) may be found. Tall shrubs are uncommon, but may occur in patches (Sims et al. 1989). The most common of these are *Alnus viridis* (green alder) and *Amelanchier alnifolia* (Saskatoon serviceberry). In the Midwest, occasional grubs of *Quercus ellipsoidalis* (northern pin oak) and *Quercus macrocarpa* (bur oak) may be present. Low shrubs are abundant. These include *Arctostaphylos uva-ursi* (kinnikinnick), *Diervilla lonicera* (northern bush honeysuckle), *Juniperus communis* (common juniper), *Linnaea borealis*

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(twinflower), *Rosa acicularis* (prickly rose), and *Vaccinium* (blueberry) spp. The herbaceous layer contains many species typical of northern coniferous forests, such as *Aralia nudicaulis* (wild sarsaparilla), *Anemone quinquefolia* (nightcaps), *Cornus canadensis* (bunchberry dogwood), *Fragaria virginiana* (Virginia strawberry), *Maianthemum canadense* (Canada mayflower), and *Trientalis borealis* (starflower). Mosses, especially *Pleurozium schreberi* (Schreber's big red stem moss), form a nearly continuous carpet (Eyre 1980, Sims et al. 1989).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus banksiana* (jack pine)
Herb (field)	Dwarf-shrub	*Gaylussacia baccata* (black huckleberry), *Vaccinium angustifolium* (lowbush blueberry)
Herb (field)	Fern or fern ally	*Pteridium aquilinum* (western brackenfern)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Gaultheria procumbens* (eastern teaberry), *Gaylussacia baccata* (black huckleberry), *Pinus banksiana* (jack pine), *Pteridium aquilinum* (western brackenfern), *Vaccinium angustifolium* (lowbush blueberry)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (3-Oct-1996).

CLASSIFICATION

Classification Confidence: 2 - Moderate

Global Comments: *Pinus banksiana / Arctostaphylos uva-ursi* Forest (CEGL002438) in northwestern Minnesota and southeastern Manitoba appears to be similar to this community, but is on deeper sands. This type also overlaps with *Pinus banksiana - (Pinus resinosa) - Quercus ellipsoidalis / Carex pensylvanica* Forest (CEGL002478), especially in Wisconsin, where timber management can cause a lot of variation in the proportion of oak and pine (E. Epstein pers. comm. 2000).

Global Similar Associations:

- *Pinus banksiana - (Picea mariana, Pinus strobus) / Vaccinium* spp. Rocky Woodland (CEGL002483)
- *Pinus banksiana - (Pinus resinosa) - Quercus ellipsoidalis / Carex pensylvanica* Forest (CEGL002478)--This is the mixed pine-oak type on sands.
- *Pinus banksiana - (Pinus resinosa) / Corylus cornuta* Forest (CEGL002442)
- *Pinus banksiana - (Quercus ellipsoidalis) / Schizachyrium scoparium* - Prairie Forbs Wooded Herbaceous Vegetation (CEGL002490)
- *Pinus banksiana - Pinus resinosa - (Quercus ellipsoidalis) / Carex pensylvanica* Wooded Herbaceous Vegetation (CEGL005124)
- *Pinus banksiana - Pinus resinosa / Quercus ellipsoidalis* Woodland (CEGL002484)
- *Pinus banksiana / Arctostaphylos uva-ursi* Forest (CEGL002438)--This community occurs on deep, sandy lacustrine plains and beach dunes, with a high fire frequency. It is drier and possible on less fertile soils.

Global Related Concepts:

- Dry Northern Forest - Jack Pine (Northern Pin Oak) (Chapman et al. 1989) =
- Jack Pine - Feathermoss (Zoladeski et al. 1995) =
- Jack Pine / Ericaceous Shrub / Feathermoss (V29) (Sims et al. 1989) B
- Jack Pine Forest (Gawler 2002) =
- Jack Pine: 1 (Eyre 1980) B
- Oligotrophic Fresh *Arctostaphylos-Linnaea* Type on Low Beta- and Gamma-gley Podzols (Mueller-Dombois 1964) =

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Lasso Road.

Global Range: This jack pine forest community is found in the northern parts of the midwestern United States and in central Canada, ranging from northern Michigan and northern Wisconsin west and north to Minnesota, southeastern Manitoba, and northwestern Ontario. Disjunct occurrences are known from western Maine and possibly New York.

Nations: CA, US

States/Provinces: MB:S4S5, ME:S1, MI:S4, MN:S3, NB, NY, ON, QC, WI:S3

USFS Ecoregions (1994/95): 212Ha:CC?, 212Hb:CCP, 212He:CC?, 212Hh:CC?, 212Hi:CCC, 212Hj:CC?, 212Hk:CC?, 212Hl:CCC, 212Hm:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hv:CCP, 212Hw:CCC, 212Hy:CCC, 212Ia:CCC, 212Ib:CCP, 212Ja:CCP, 212Jc:CCP, 212Jl:CCP, 212Jm:CCC, 212Jn:CCP, 212Jo:CC?, 212Ka:CCC, 212Na:CCC, 212Nb:CCP, 212Nc:CCC, 212:Oa:CCC, M212Af:CCC, M212D:CP

Federal Lands: NPS (Apostle Islands, Pictured Rocks, Sleeping Bear Dunes); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Hiawatha, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.54.

Sleeping Bear Dunes National Lakeshore Map Code: FJB

Local Description Authors: M.J. Russo

Global Description Authors: J. Drake

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References: Chapman et al. 1989, Epstein pers. comm., Eyre 1980, Farrand and Bell 1982, Gawler 2002, Greenall 1996, MNNHP 1993, Midwestern Ecology Working Group n.d., Mueller-Dombois 1964, Sims et al. 1989, WNHIP unpubl. data, Zoladeski et al. 1995

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G048. White Spruce - Balsam Fir Forest Group

Spruce - Fir - Aspen Forest

***Picea glauca - Abies balsamea - Populus tremuloides* / Mixed Herbs Forest**
White Spruce - Balsam Fir - Quaking Aspen / Mixed Herbs Forest
Identifier: CEGL002475

NVC CLASSIFICATION

Division	North American Boreal Forest (1.D.1.Na)
Macrogroup	Eastern & Central North American Boreal Conifer & Hardwood Forest (M037)
Group	White Spruce - Balsam Fir Forest Group (G048)
Association (Common name)	Spruce - Fir - Aspen Forest
Ecological System(s):	Boreal White Spruce-Fir-Hardwood Forest (CES103.021)

ELEMENT CONCEPT

Global Summary: This spruce - fir - aspen forest is found in the western Great Lakes area of the United States and Canada and elsewhere in parts of central Canada. Stands occur on deep, well-drained to rapidly drained, moist, fine-textured mineral soils. Loams are the most common, but silts and clays are also possible. The overstory is a mixture of coniferous and deciduous trees. Species composition is varied. The most abundant tree species are *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Picea glauca* (white spruce), *Pinus strobus* (eastern white pine), *Populus tremuloides* (quaking aspen), and *Populus balsamifera* (balsam poplar). The sapling/shrub layer is usually moderately well-developed. *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), *Rosa acicularis* (prickly rose), *Rubus pubescens* (dwarf red blackberry), and saplings of *Abies balsamea* (balsam fir) are the most commonly encountered in this stratum. Herb diversity is usually high. *Aralia nudicaulis* (wild sarsaparilla), *Symphyotrichum ciliolatum* (Lindley's aster), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), and *Trientalis borealis* (starflower) are typical of this community. A Lake Superior clayplain variant may occur in northern Wisconsin.

ENVIRONMENTAL DESCRIPTION

Global Environment: This upland community is found on deep, well-drained to rapidly drained, moist, fine-textured mineral soils. Loams are the most common, but silts and clays are not rare (Sims et al. 1989, Zoladeski et al. 1995).

VEGETATION DESCRIPTION

Global Vegetation: The overstory composition is varied. The most abundant tree species typically are *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Picea glauca* (white spruce), *Pinus strobus* (eastern white pine), *Populus tremuloides* (quaking aspen), and *Populus balsamifera* (balsam poplar). The sapling/shrub layer is usually moderately well-developed. *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), *Rosa acicularis* (prickly rose), *Rubus pubescens* (dwarf red blackberry), and saplings of *Abies balsamea* (balsam fir) are the most commonly encountered in this stratum. Herb diversity is usually high. *Aralia nudicaulis* (wild sarsaparilla), *Symphyotrichum ciliolatum* (Lindley's aster), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), and *Trientalis borealis* (starflower) are typical of this community (Sims et al. 1989, MNNHP 1993). A Lake Superior clayplain variant may occur in northern Wisconsin. Leading canopy dominants include *Picea glauca* (white spruce), *Pinus strobus* (eastern white pine), and *Betula papyrifera* (paper birch). Common associates include *Abies balsamea* (balsam fir), *Populus tremuloides* (quaking aspen), *Populus balsamifera* (balsam poplar), *Thuja occidentalis* (northern white-cedar), and *Acer rubrum* (red maple). Shrubs include *Cornus sericea* (red-osier dogwood), *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Lonicera hirsuta* (hairy honeysuckle), *Rubus parviflorus* (thimbleberry), *Rubus pubescens* (dwarf red blackberry), *Sorbus decora* (northern mountain-ash), and *Viburnum opulus* var. *americanum* (American cranberrybush). Typical herbaceous species include *Anemone quinquefolia* (nightcaps), *Eurybia macrophylla* (bigleaf aster), *Aralia nudicaulis* (wild sarsaparilla), *Calamagrostis canadensis* (bluejoint), *Carex arctata* (drooping woodland sedge), *Fragaria virginiana* (Virginia strawberry), *Luzula acuminata* (hairy woodrush), *Maianthemum canadense* (Canada mayflower), *Petasites frigidus* (arctic sweet coltsfoot), and *Pteridium aquilinum* (western brackenfern) (E. Epstein pers. comm. 1999).

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (3-Oct-1996). No old-growth stands are known for the Lake Superior clayplain variant.

CLASSIFICATION

Classification Confidence: 2 - Moderate
Global Comments: This type overlaps in concept with *Abies balsamea - Betula papyrifera / Diervilla lonicera* Forest (CEGL002474). A red maple variant may occur in the Great Lake states (Michigan, Minnesota, Wisconsin). The Lake Superior clayplain variant should be reviewed range-wide to see if it may represent a distinct association.
Global Similar Associations:

- *Abies balsamea - Betula papyrifera / Diervilla lonicera* Forest (CEGL002474)
- *Picea glauca - Abies balsamea / Acer spicatum / Rubus pubescens* Forest (CEGL002446)
- *Populus tremuloides - (Populus grandidentata)* Rocky Woodland (CEGL002487)
- *Populus tremuloides - Populus balsamifera* - Mixed Hardwoods Lowland Forest (CEGL005036)

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Global Related Concepts:

- White Spruce Mixedwood (V13) (Zoladeski et al. 1995) =
- White Spruce Mixedwood (V15) (Sims et al. 1989) =

ELEMENT DISTRIBUTION

Global Range: This spruce - fir - aspen forest type is found in the western Great Lakes area of the United States and Canada and elsewhere in parts of central Canada, ranging from northern Minnesota and Manitoba east to Michigan and possibly Quebec.
Nations: CA, US
States/Provinces: MB:S4S5, MI, MN, ON, QC, WI:S2
USFS Ecoregions (1994/95): 212He:CC?, 212Hi:CCC, 212Hl:CCP, 212Hm:CCP, 212Hn:CCP, 212Ho:CCP, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Hv:CCP, 212Hw:CCP, 212Ia:CCP, 212Ib:CCC, 212Ja:CCP, 212Jb:CCP, 212Jc:CCP, 212Jl:CCP, 212Jm:CCC, 212Jn:CCP, 212Jo:CCP, 212La:CCC, 212Lb:CCC, 212Lc:CCC, 212Mb:CCC, 212Na:CPP, 212Nb:CPP, 212Nc:CPP, 212:Oa:CCC, 212Ob:C??, 222Ma:CCC, 222Na:CCC
Federal Lands: NPS (Grand Portage, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chippewa, Hiawatha, Huron, Huron-Manistee, Manistee, Ottawa, Superior)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: This association was not sampled with plots at Sleeping Bear Dunes NL.
Sleeping Bear Dunes National Lakeshore Map Code: FCP
Local Description Authors: NA
Global Description Authors: J. Drake
References: Epstein pers. comm., Greenall 1996, MNNHP 1993, Midwestern Ecology Working Group n.d., Sims et al. 1989, WNHIP unpubl. data, Zoladeski et al. 1995

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1.D.2. Boreal Flooded & Swamp Forest

1.D.2.Na. North American Boreal Flooded & Swamp Forest

M299. North American Boreal Swamp Forest

G050. Eastern Black Spruce - Tamarack Acidic Swamp Group

Black Spruce - Tamarack / Labrador-tea Poor Swamp

***Picea mariana - (Larix laricina) / Ledum groenlandicum / Sphagnum* spp. Forest**
Black Spruce - (Tamarack) / Bog Labrador-tea / Peatmoss species Forest
Identifier: CEGL005271

NVC CLASSIFICATION

Division	North American Boreal Flooded & Swamp Forest (1.D.2.Na)
Macrogroup	North American Boreal Swamp Forest (M299)
Group	Eastern Black Spruce - Tamarack Acidic Swamp Group (G050)
Association (Common name)	Black Spruce - Tamarack / Labrador-tea Poor Swamp
Ecological System(s):	Boreal-Laurentian Conifer Acidic Swamp and Treed Poor Fen (CES103.724)
	Boreal-Laurentian Bog (CES103.581)

ELEMENT CONCEPT

Global Summary: This community is found in the northern Great Lakes and Northern Appalachian/Boreal region of the United States and Canada and elsewhere in the boreal regions of central and eastern Canada. Sites are found on level, wet sites with organic soils, but not generally as components of large open peatlands. These sites are poorly drained and acidic, allowing a moderate to thick layer of peat to accumulate. Nutrient levels are very low. The overstory of this community is dominated by conifers. The tree canopy is closed to broken to closed with a moderately well-developed low-shrub layer, sparse herbaceous layer, and a carpet of mosses. The canopy is often pure *Picea mariana* (black spruce). The only other trees that are occasionally found with it are *Abies balsamea* (balsam fir), *Larix laricina* (tamarack), and *Pinus banksiana* (jack pine). The shrubs are primarily ericaceous and include *Chamaedaphne calyculata* (leatherleaf), *Gaultheria hispidula* (creeping snowberry), *Kalmia polifolia* (bog laurel), *Ledum groenlandicum* (bog Labrador-tea), and *Vaccinium myrtilloides* (velvetleaf huckleberry), as well as *Cornus canadensis* (bunchberry dogwood). In the Northeast, shrubs may include *Kalmia angustifolia* (sheep laurel), *Nemopanthus mucronatus* (catberry), *Viburnum nudum* var. *cassinoides* (withe-rod), or *Rhododendron canadense* (rhodora). The few herbaceous species that live in this community include *Carex trisperma* (threeseeded sedge), *Eriophorum vaginatum* var. *spissum* (tussock cottongrass), *Clintonia borealis* (bluebead), and *Maianthemum trifolium* (threeleaf false lily of the valley). *Sphagnum* (sphagnum) spp., *Dicranum polysetum* (dicranum moss), and *Pleurozium schreberi* (Schreber's big red stem moss) are the major species constituting the abundant moss layer.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This black spruce - tamarack swamp forest was sampled once on North Manitou Island. The site is a saturated lakeplain with poorly drained peat soil. The unvegetated surface is made up of leaf litter (38% cover), wood (2%), dead plant stems (20%) and sphagnum mosses (40%). Evidence of disturbance includes dead standing trees (80% of trees within sampled plot), possibly to hydrologic changes resulting from beaver activity in the area.
Global Environment: This community is found on level, wet sites with organic soils (Zoladeski et al. 1995). These sites are poorly to very poorly drained and acidic, allowing a moderate to thick layer of peat to accumulate. Nutrient levels are very low (Kurmis et al. 1986).

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The moderate (40% cover) tree canopy, 10-15 m tall, is dominated by *Larix laricina* (tamarack) along with a lesser amount of *Picea mariana* (black spruce). The moderate (50%) tall-shrub layer (2-5 m) is codominated by *Acer rubrum* (red maple) and *Betula alleghaniensis* (yellow birch) and includes small amounts of the canopy species. The very dense (90%) short-shrub layer (1-2 m) is dominated by *Chamaedaphne calyculata* (leatherleaf) (70% cover) and includes small amounts of *Nemopanthus mucronatus* (catberry) and *Photinia floribunda* (purple chokeberry). *Gaylussacia baccata* (black huckleberry) and *Vaccinium myrtilloides* (velvetleaf huckleberry) form a very sparse (10%) dwarf-shrub layer. The very sparse (10%) herbaceous layer includes *Carex trisperma* (threeseeded sedge), *Coptis trifolia* (threeleaf goldthread), *Dryopteris carthusiana* (spinulose woodfern), *Scirpus cyperinus* (woolgrass), and *Triadenum fraseri* (Fraser's marsh St. Johnswort). Nonvascular species (sphagnum mosses) cover 50% of the ground surface.
Global Vegetation: The overstory of this community is dominated by conifers. The tree canopy is closed to broken to closed with a moderately well-developed low-shrub layer, sparse herbaceous layer, and a carpet of mosses (Kurmis et al. 1986). The canopy is often pure *Picea mariana* (black spruce). *Abies balsamea* (balsam fir) can be present as a codominant. The only other trees that are occasionally found with it are *Larix laricina* (tamarack) and *Pinus banksiana* (jack pine) (Sims et al. 1989). The shrubs are primarily ericaceous and include *Chamaedaphne calyculata* (leatherleaf), *Gaultheria hispidula* (creeping snowberry), *Kalmia polifolia* (bog laurel), *Ledum groenlandicum* (bog Labrador-tea), and *Vaccinium* (blueberry) spp., as well as *Cornus canadensis* (bunchberry dogwood). In the Northeast, shrubs may include *Kalmia angustifolia* (sheep laurel), *Nemopanthus mucronatus* (catberry), *Viburnum*

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nudum var. *cassinoides* (withe-rod), or *Rhododendron canadense* (rhodora). The few herbaceous species that live in this community include *Carex lasiocarpa* (woollyfruit sedge), *Carex trisperma* (threeseeded sedge), *Eriophorum vaginatum* var. *spissum* (tussock cottongrass), *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), and *Maianthemum trifolium* (threeleaf false lily of the valley). *Dicranum polysetum* (dicranum moss), *Sphagnum* (sphagnum) spp., and *Pleurozium schreberi* (Schreber's big red stem moss) are the major species constituting the abundant moss layer (Damman and French 1987, Sims et al. 1989, Harris et al. 1996). Localized minerotrophic areas may contain a more diverse herbaceous layer, including species such as *Osmunda cinnamomea* (cinnamon fern).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Larix laricina* (tamarack)
Short shrub/sapling	Broad-leaved evergreen shrub	*Chamaedaphne calyculata* (leatherleaf)
Herb (field)	Dwarf-shrub	*Gaylussacia baccata* (black huckleberry)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Chamaedaphne calyculata* (leatherleaf), *Gaylussacia baccata* (black huckleberry), *Larix laricina* (tamarack), *Picea mariana* (black spruce)

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (27-Jun-2000).

CLASSIFICATION

Classification Confidence: 2 - Moderate

Global Comments: This type represents poor black spruce swamps in closed peatland basins. Conceptually, it overlaps with black spruce bog forests, *Picea mariana / Ledum groenlandicum / Carex trisperma / Sphagnum* spp. Forest (CEGL002485), which are more typically found in open peatland complexes. This type is found in smaller basins, where a weakly minerotrophic influence is more likely. In the Northern Appalachian/Boreal ecoregion, *Abies balsamea* (balsam fir) differentiates this type from bogs of lower elevations and latitudes. Stands in northeast U.S. and Canada may also contain a suite of shrub species, such as *Kalmia angustifolia* (sheep laurel), *Nemopanthus mucronatus* (catberry), *Viburnum nudum* var. *cassinoides* (withe-rod), or *Rhododendron canadense* (rhodora). These species differ from those in the midwestern U.S. and central Canada, but their constancy in this type needs further evaluation.

Global Similar Associations:

- *Larix laricina / Alnus incana* Forest (CEGL002471)
- *Picea mariana / (Vaccinium corymbosum, Gaylussacia baccata) / Sphagnum* sp. Woodland (CEGL006098)
- *Picea mariana / Alnus incana / Sphagnum* spp. Forest (CEGL002452)--is similar but tends to have a greater diversity and coverage of herbs and to be more nutrient-rich.
- *Picea mariana / Ledum groenlandicum / Carex trisperma / Sphagnum* spp. Forest (CEGL002485)--overlaps.
- *Picea mariana / Pleurozium schreberi* Forest (CEGL002447)
- *Pinus banksiana - (Picea mariana)* - Mixed Hardwoods / *Sphagnum* spp. Forest (CEGL005166)
- *Populus tremuloides - (Populus grandidentata)* Rocky Woodland (CEGL002487)
- *Thuja occidentalis - Larix laricina / Sphagnum* spp. Forest (CEGL005225)

Global Related Concepts:

- *Carex trisperma* - Black spruce forest (Damman and French 1987) =
- *Habenario - Picetum* Association (Janssen 1967) =
- Black Spruce (eastern type): 12 (Eyre 1980) B
- Black Spruce - *Kalmia* Type (Kurmis et al. 1986) =
- Black Spruce / Bunchberry / Sphagnum (Feathermoss) (V36) (Sims et al. 1989) F
- Black Spruce / Ericaceous Shrub / Sphagnum (V37) (Sims et al. 1989) F
- Black Spruce / Herb Poor / Sphagnum (Feathermoss) (Zoladeski et al. 1995) =
- Black Spruce / Labrador Tea / Feathermoss (Sphagnum) (V34) (Sims et al. 1989) F
- Black Spruce Bog (Woodland) (Thompson 1996) ?
- Palustrine Scrub-Shrub Needle-leaved Evergreen Saturated Wetland (PSS4B) (Cowardin et al. 1979) ?
- Poor Conifer Swamp - Black Spruce (Tamarack) Swamp (Chapman et al. 1989) =
- Poor conifer swamp: black spruce / Labrador Tea / Sphagnum (W27) (Harris et al. 1996) F
- Poor conifer swamp: black spruce / Labrador Tea / bluejoint grass (W28) (Harris et al. 1996) F
- Spring-fen forest (Glaser 1992b) =
- Spruce - Larch Wooded Bog (Gawler 2002) B

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled on North Manitou Island.

Global Range: This community is found in the northern Great Lakes region and Northern Appalachian-Acadian region of the United States and Canada and elsewhere in the boreal regions of central Canada. It ranges from northern Michigan to northern Minnesota, and northward to parts of Manitoba, Ontario, Quebec, and the Atlantic Provinces.

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Nations: CA, US
States/Provinces: MB:S5, ME, MI:S4, MN, NB, NH, NY, ON, PA, QC:S4, VT:S2, WI:S3S4
USFS Ecoregions (1994/95): 212Aa:CCC, 212Ab:CCC, 212Ba:CCC, 212Bb:CCC, 212Ca:CCC, 212Cb:CCC, 212Da:CCC, 212Dc:CCC, 212Ha:CCP, 212Hb:CCP, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCC, 212Hk:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCC, 212Hr:CCP, 212Hs:CCP, 212Hv:CCP, 212Hw:CCC, 212Ia:CCC, 212Ib:CCC, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Je:CPP, 212Jf:CPP, 212Jj:CPP, 212Jk:CPP, 212Jl:CPP, 212Jm:CPP, 212Jn:CPP, 212Jo:CPP, 212Jr:CPP, 212Ka:CCP, 212Kb:CCC, 212La:CCC, 212Lb:CCC, 212Lc:CCC, 212Ld:CCC, 212Ma:CCC, 212Mb:CCC, 212Na:CCC, 212Nb:CCC, 212Nc:CCC, 212:Oa:CCC, 221Ag:CCC, 221Ah:CCC, 221Ai:CCC, 221Ak:CCC, 221Al:CCC, M212Aa:CCC, M212Ab:CCC, M212Ac:CCC, M212Ad:CCC, M212Ae:CCC, M212Af:CCC, M212Ag:CCC, M212Ba:CCC, M212Ca:CCC, M212Cd:CCC, M212Da:CCC, M212Db:CCC, M212Dc:CCC, M212Dd:CCP
Federal Lands: NPS (Acadia, Apostle Islands, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Hiawatha?, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa, Superior)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.111.
Sleeping Bear Dunes National Lakeshore Map Code: FSS, FTP
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Anderson and Davis 1997, Chapman et al. 1989, Cowardin et al. 1979, Damman and French 1987, Edinger et al. 2002, Eyre 1980, Farrand and Bell 1982, Fike 1999, Gawler 2002, Glaser 1992b, Harris et al. 1996, Janssen 1967, Kurmis et al. 1986, MNNHP 1993, Midwestern Ecology Working Group n.d., Sims et al. 1989, Sperduto 2000b, Thompson 1996, Thompson and Sorenson 2000, WNHIP unpubl. data, Zoladeski et al. 1995

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G051. Eastern Tamarack - Conifer Alkaline Swamp Group

Northern Tamarack Rich Swamp

***Larix laricina / Alnus incana* Forest**
Tamarack / Gray Alder Forest
Identifier: CEGL002471

NVC CLASSIFICATION

Division	North American Boreal Flooded & Swamp Forest (1.D.2.Na)
Macrogroup	North American Boreal Swamp Forest (M299)
Group	Eastern Tamarack - Conifer Alkaline Swamp Group (G051)
Association (Common name)	Northern Tamarack Rich Swamp
Ecological System(s):	Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575)

ELEMENT CONCEPT

Global Summary: This rich to moderately poor tamarack swamp community is found in the northern Great Lakes region of the United States and Canada. Stands are found on the shores of lakes and rivers above the flooding level, as well as margins of flowage areas of peatland complexes. The substrate is primarily a well-decomposed woody peat in wet, saturated soils, but can also be a moist mineral soil. The canopy layer varies from closed (60-100% cover) to open (25-60% cover), and varies from 3-10 m in height. *Larix laricina* (tamarack) is the dominant tree species, with associates of *Picea mariana* (black spruce) and *Thuja occidentalis* (northern white-cedar). The shrub, herb and moss layers can be very rich to somewhat poor. The shrub layer typically contains *Alnus incana* (gray alder), along with *Abies balsamea* (balsam fir), *Cornus sericea* (red-osier dogwood), *Rhamnus alnifolia* (alderleaf buckthorn), and *Picea mariana* (black spruce). The dwarf-shrub layer is strongly ericaceous, including *Ledum groenlandicum* (bog Labrador-tea) and *Gaultheria hispidula* (creeping snowberry). Other dwarf-shrubs include *Cornus canadensis* (bunchberry dogwood), *Linnaea borealis* (twinflower), *Lonicera villosa* (mountain fly honeysuckle), *Ribes triste* (red currant), *Rosa acicularis* (prickly rose), and *Rubus pubescens* (dwarf red blackberry). Herbaceous species include *Carex disperma* (softleaf sedge), *Carex aquatilis* (water sedge), *Coptis trifolia* (threeleaf goldthread), *Equisetum sylvaticum* (woodland horsetail), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Maianthemum trifolium* (threeleaf false lily of the valley), *Mitella nuda* (naked miterwort), *Trientalis borealis* (starflower), and *Viola renifolia* (white violet). The moss layer, which is sometimes patchy, includes *Dicranum polysetum* (dicranum moss), *Hylocomium splendens* (splendid feather moss), *Pleurozium schreberi* (Schreber's big red stem moss), *Ptilium crista-castrensis* (knights plume moss), *Rhytidiadelphus triquetrus* (rough gooseneck moss), *Sphagnum capillifolium* (sphagnum), and *Sphagnum girgensohnii* (Girgensohn's sphagnum). Diagnostic characteristics include the dominance of *Larix laricina* (tamarack), presence of both minerotrophic shrubs (*Alnus incana* (gray alder), *Cornus sericea* (red-osier dogwood)) and some ericaceous shrubs (e.g., *Ledum groenlandicum* (bog Labrador-tea)), and the incomplete moss layer.

ENVIRONMENTAL DESCRIPTION

Global Environment: Stands are found on the shores of lakes and rivers above the flooding level, as well as margins of flowage areas of peatland complexes. The substrate is primarily a well-decomposed woody peat in wet, saturated soils, but can also be a moist mineral soil (Sims et al. 1989, MNNHP 1993, Harris et al. 1996).

VEGETATION DESCRIPTION

Global Vegetation: The canopy layer varies from closed (60-100% cover) to open (25-60% cover), and may also range from 3-10 m in height. *Larix laricina* (tamarack) is the dominant tree species, with associates of *Picea mariana* (black spruce) and *Thuja occidentalis* (northern white-cedar). The shrub, herb and moss layers can be very rich to somewhat poor. The shrub layer typically contains *Alnus incana* (gray alder), along with *Abies balsamea* (balsam fir), *Cornus sericea* (red-osier dogwood), *Rhamnus alnifolia* (alderleaf buckthorn), and *Picea mariana* (black spruce). The dwarf-shrub layer is strongly ericaceous, including *Ledum groenlandicum* (bog Labrador-tea) and *Gaultheria hispidula* (creeping snowberry). Other dwarf-shrubs include *Cornus canadensis* (bunchberry dogwood), *Linnaea borealis* (twinflower), *Lonicera villosa* (mountain fly honeysuckle), *Ribes triste* (red currant), *Rosa acicularis* (prickly rose), and *Rubus pubescens* (dwarf red blackberry). Herbaceous species include *Carex disperma* (softleaf sedge), *Coptis trifolia* (threeleaf goldthread), *Equisetum sylvaticum* (woodland horsetail), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Maianthemum trifolium* (threeleaf false lily of the valley), *Mitella nuda* (naked miterwort), *Trientalis borealis* (starflower), and *Viola renifolia* (white violet). The moss layer, which is sometimes patchy, includes *Dicranum polysetum* (dicranum moss), *Hylocomium splendens* (splendid feather moss), *Pleurozium schreberi* (Schreber's big red stem moss), *Ptilium crista-castrensis* (knights plume moss), *Rhytidiadelphus triquetrus* (rough gooseneck moss), *Sphagnum capillifolium* (sphagnum), *Sphagnum girgensohnii* (Girgensohn's sphagnum), and *Sphagnum capillifolium* (sphagnum) (Sims et al. 1989, MNNHP 1993, Harris et al. 1996).

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (3-Oct-1996).

CLASSIFICATION

Classification Confidence: 2 - Moderate
Global Comments: This type in concept is found in the boreal/mixed conifer-hardwood region (Province 212). It varies from having a tall-shrub layer and more minerotrophic indicators to a more patchy layer with dwarf-shrub/sphagnum mat and fewer minerotrophic

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indicators. This type lacks the more southern species found in central tamarack minerotrophic swamps, such as *Larix laricina / Photinia melanocarpa / Sphagnum* spp. Forest (CEGL002472), which is found in the hardwood and prairie-forest border regions.

Global Similar Associations:

- *Acer rubrum - Fraxinus* spp. - *Betula papyrifera / Cornus canadensis* Forest (CEGL002071)
- *Larix laricina - Acer rubrum / (Rhamnus alnifolia, Vaccinium corymbosum)* Forest (CEGL005232)--is a more southern minerotrophic version of this type.
- *Larix laricina / Photinia melanocarpa / Sphagnum* spp. Forest (CEGL002472)--This type has a more southern distribution and is more nutrient-poor.
- *Picea mariana - (Larix laricina) / Ledum groenlandicum / Sphagnum* spp. Forest (CEGL005271)
- *Thuja occidentalis - Larix laricina / Sphagnum* spp. Forest (CEGL005225)

Global Related Concepts:

- Forested fingers (Glaser 1992b) =
- Rich conifer swamp: cedar-(tamarack) (W32) (Harris et al. 1996) I
- Tamarack (Black Spruce) / Speckled Alder / Labrador Tea (V23) (Sims et al. 1989) =

ELEMENT DISTRIBUTION

Global Range: This rich to moderately poor tamarack swamp community is found in the northern Great Lakes region of the United States and Canada, ranging from the northern and central parts of Minnesota, Wisconsin, and Michigan to Ontario, Manitoba, and probably elsewhere.

Nations: CA, US

States/Provinces: MB:S4?, MI, MN, ON, QC:S4?, WI

USFS Ecoregions (1994/95): 212Ha:CCP, 212Hb:CCP, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCP, 212Hk:CCP, 212Hl:CCP, 212Hm:CCP, 212Hn:CCP, 212Ho:CCP, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hv:CCP, 212Hw:CCP, 212Hy:CCP, 212Ia:CCC, 212Ib:CC?, 212Ja:CCC, 212Jb:CCP, 212Jc:CCP, 212Jk:CCP, 212Jl:CCP, 212Jm:CCP, 212Jn:CCP, 212Jo:CCP, 212Jr:CCP, 212Ka:CCP, 212Kb:CCC, 212La:CCC, 212Mb:CCC, 212Na:CCC, 212Nb:CCP, 212Nc:CCC, 212:Oa:CCC, 222Na:CCC, M212:C

Federal Lands: NPS (Apostle Islands, Isle Royale, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa, Superior)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: This association was not sampled with plots at Sleeping Bear Dunes NL.

Sleeping Bear Dunes National Lakeshore Map Code: FTR

Local Description Authors: NA

Global Description Authors: J. Drake

References: Brewer 1966, Catana 1967, Glaser 1992b, Greenall 1996, Harris et al. 1996, MNNHP 1993, Midwestern Ecology Working Group n.d., Sims et al. 1989, Sytsma and Pippen 1981a, Sytsma and Pippen 1981b

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White-cedar - (Mixed Conifer) / Alder Swamp

***Thuja occidentalis* - *(Picea mariana, Abies balsamea) / Alnus incana* Forest**
Northern White-cedar - (Black Spruce, Balsam Fir) / Gray Alder Forest
Identifier: CEGL002456

NVC CLASSIFICATION

Division	North American Boreal Flooded & Swamp Forest (1.D.2.Na)
Macrogroup	North American Boreal Swamp Forest (M299)
Group	Eastern Tamarack - Conifer Alkaline Swamp Group (G051)
Association (Common name)	White-cedar - (Mixed Conifer) / Alder Swamp
Ecological System(s):	Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575)
	Great Lakes Wooded Dune and Swale (CES201.726)

ELEMENT CONCEPT

Global Summary: This sub-boreal northern white-cedar - mixed conifer swamp forest is found in the northern Great Lakes region of the United States and Canada. Stands occur on level to gently sloping ground with wet, organic or mineral soil. It is typically along the margins of peatlands, in drainage courses, shores of lakes and rivers above flooding level, or in shallow depressions. The groundwater is moderately minerotrophic and has circumneutral pH. The canopy is often moderately dense to dense. The understory structure consists of high hummocks and deep, water-filled hollows, with fallen, moss-covered logs common. *Thuja occidentalis* (northern white-cedar) is moderately to strongly dominant in the canopy, or *Picea mariana* (black spruce) may overtop the subdominant *Thuja occidentalis* (northern white-cedar). Other species include *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Fraxinus nigra* (black ash), *Larix laricina* (tamarack) and, more rarely, *Picea glauca* (white spruce), or *Tsuga canadensis* (eastern hemlock). The shrub layer in this community is sparse to dense, in inverse proportion to the tree canopy. Species present in this stratum include *Alnus incana* (gray alder), *Chamaedaphne calyculata* (leatherleaf), *Cornus canadensis* (bunchberry dogwood), *Cornus sericea* (red-osier dogwood), *Gaultheria hispidula* (creeping snowberry), *Ledum groenlandicum* (bog Labrador-tea), *Linnaea borealis* (twinflower), *Rosa acicularis* (prickly rose), *Rubus pubescens* (dwarf red blackberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry). *Nemopanthus mucronatus* (catberry) and *Viburnum nudum* var. *cassinoides* (withe-rod) are more common eastward. The most common herbaceous species are *Carex* (sedge) spp. (including *Carex disperma), Coptis trifolia* (threeleaf goldthread), *Clintonia borealis* (bluebead), *Dryopteris carthusiana* (spinulose woodfern), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), *Trientalis borealis* (starflower), and *Viola renifolia* (white violet). Mosses include *Hylocomium splendens* (splendid feather moss), *Pleurozium schreberi* (Schreber's big red stem moss), *Ptilium crista-castrensis* (knights plume moss), *Rhytidiadelphus triquetrus* (rough gooseneck moss), *Sphagnum capillifolium* (sphagnum), *Sphagnum girgensohnii* (Girgensohn's sphagnum), and *Sphagnum magellanicum* (Magellan's sphagnum). Moss cover may be thin where the canopy is very dense. Diagnostic species include *Thuja occidentalis* (northern white-cedar) as a dominant/codominant species, with a combination of acidic and minerotrophic understory species, such as *Alnus incana* (gray alder) and *Cornus sericea* (red-osier dogwood).

ENVIRONMENTAL DESCRIPTION

Global Environment: This community is found on level to gently sloping ground with wet, organic (Sims et al. 1989) or mineral soil (MNNHP 1993). It is typically along the margins of peatlands, in drainage courses, or shallow depressions. Schwintzer and Tomberlin (1982) reported detailed results on the chemical characteristics of the groundwater of several wetland types in Lower Michigan. They found that it was difficult to differentiate swamps dominated by conifers from those dominated by other vegetation on the basis of groundwater. The swamps were moderately to strongly minerotrophic and had circumneutral pH.

VEGETATION DESCRIPTION

Global Vegetation: The canopy is often moderately dense to dense (MNNHP 1993). Basal areas of 42.2-62.2 m2/ha and densities of 2457-7565 stems/ha have been reported in four stands in Lower Michigan, using a tree definition of woody stems greater than 2.5 cm dbh (Schwintzer 1981). The understory structure consists of high hummocks and deep, water-filled hollows, with fallen, moss-covered logs common. *Thuja occidentalis* (northern white-cedar) is moderately to strongly dominant in the canopy, or *Picea mariana* (black spruce) may overtop the subdominant *Thuja occidentalis* (northern white-cedar). Other species include *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Fraxinus nigra* (black ash), *Larix laricina* (tamarack) and, more rarely, *Picea glauca* (white spruce) (in northern Minnesota and northwestern Ontario), or *Tsuga canadensis* (eastern hemlock). The shrub layer in this community is sparse to dense, in inverse proportion to the tree canopy. Species present in this stratum include *Alnus incana* (gray alder), *Chamaedaphne calyculata* (leatherleaf), *Cornus canadensis* (bunchberry dogwood), *Cornus sericea* (red-osier dogwood), *Gaultheria hispidula* (creeping snowberry), *Ledum groenlandicum* (bog Labrador-tea), *Linnaea borealis* (twinflower), *Rosa acicularis* (prickly rose), *Rubus pubescens* (dwarf red blackberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry). *Nemopanthus mucronatus* (catberry) and *Viburnum nudum* var. *cassinoides* (withe-rod) are more common eastward. The most common herbaceous species are *Carex* (sedge) spp. (including *Carex disperma), Coptis trifolia* (threeleaf goldthread), *Clintonia borealis* (bluebead), *Dryopteris carthusiana* (spinulose woodfern), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), *Trientalis borealis* (starflower), and *Viola renifolia* (white violet). Mosses include *Hylocomium splendens* (splendid feather moss), *Pleurozium schreberi* (Schreber's big red stem moss), *Ptilium crista-castrensis* (knights plume moss), *Rhytidiadelphus triquetrus* (rough gooseneck moss), *Sphagnum capillifolium* (sphagnum), *Sphagnum*

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girgensohnii (Girgensohn's sphagnum), and *Sphagnum magellanicum* (Magellan's sphagnum). Moss cover may be thin where the canopy is very dense. Diagnostic species include *Thuja occidentalis* (northern white-cedar) as a dominant/codominant species, with a combination of acidic and more minerotrophic understory species, such as *Alnus incana* (gray alder) and *Cornus sericea* (red-osier dogwood). (Sims et al. 1989, Harris et al. 1996, Chambers et al. 1997)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (3-Oct-1996). This rank may need to be higher. In Wisconsin, for example, there is very poor regeneration of cedar in many stands. There was also widespread strip cutting on federal lands several decades ago, but little cedar reproduction has occurred. Currently, there is a moratorium on cutting on federal and state lands, but cutting continues on private lands (E. Epstein pers. comm. 1999). Deer browse is also a major factor affecting regeneration (Van Deelen 1999).

CLASSIFICATION

Classification Confidence: 2 - Moderate

Global Comments: The northern white-cedar seepage type, *Thuja occidentalis - (Larix laricina)* Seepage Forest (CEGL002455) could be lumped with this type, but this type may represent more northern stands. This type may need to be separated into a slightly poorer *Thuja - Larix - Picea* type, *Thuja occidentalis - Larix laricina / Sphagnum* spp. Forest (CEGL005225), and a richer *Thuja* (red cedar) type (see Harris et al. 1996, W31, W32).

Global Similar Associations:

- *Thuja occidentalis - (Larix laricina)* Seepage Forest (CEGL002455)
- *Thuja occidentalis - Abies balsamea / Ledum groenlandicum / Carex trisperma* Woodland (CEGL006507)
- *Thuja occidentalis - Fraxinus nigra* Forest (CEGL005165)
- *Thuja occidentalis - Larix laricina / Sphagnum* spp. Forest (CEGL005225)
- *Thuja occidentalis / Abies balsamea - Acer spicatum* Forest (CEGL002449)
- *Thuja occidentalis / Sphagnum (girgensohnii, warnstorfii)* Forest (CEGL006007)--This type is found in the northeastern United States.
- *Tsuga canadensis - Betula alleghaniensis* Saturated Forest (CEGL005003)

Global Related Concepts:

- Cedar (inc. Mixedwood) / Speckled Alder / Sphagnum Forest (Sims et al. 1989) =
- Conifer Swamp (Schwintzer 1981) =
- Rich Conifer Swamp (cedar) (Chapman et al. 1989) B
- Rich conifer swamp: cedar-(tamarack) (W32) (Harris et al. 1996) I
- Segments 7 and 8 of northern swamps (Clausen 1957) =
- White Cedar-Goldthread-Sphagnum (V38) (Chambers et al. 1997) =

ELEMENT DISTRIBUTION

Global Range: This sub-boreal northern white-cedar - mixed conifer swamp forest is found in the northern Great Lakes region on level to gently sloping ground with wet, organic or mineral soil.

Nations: CA, US

States/Provinces: MB:S2, MI, MN, ON, WI:S3S4

USFS Ecoregions (1994/95): 212Ha:CCC, 212Hb:CCC, 212Hd:CCC, 212He:CCC, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hk:CCP, 212Hl:CCC, 212Hm:CCC, 212Hn:CCP, 212Ho:CCP, 212Hp:CCC, 212Hq:CCC, 212Hr:CCP, 212Hs:CCC, 212Ht:CCC, 212Hv:CCC, 212Hw:CCC, 212Hy:CCC, 212Ia:CCC, 212Ib:CCC, 212Ja:CCC, 212Jb:CCP, 212Jc:CCC, 212Je:CCP, 212Jf:CCC, 212Jj:CCC, 212Jk:CCC, 212Jl:CCC, 212Jm:CCC, 212Jn:CCP, 212Jo:CCP, 212Jr:CCP, 212Ka:CCC, 212La:CCC, 212Lb:CCP, 212Lc:CCC, 212Mb:CCC, 212Na:CCC, 212Nb:CCC, 212Nc:CCC, 212Nd:CCC, 212Oa:CCC, 212Pa:CCC, 222Jc:CCC, 222Ke:CCC, 222Mc:CCC, 222Na:CCC

Federal Lands: NPS (Apostle Islands, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Hiawatha, Huron, Huron-Manistee, Nicolet, Ottawa, Superior)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: This association was not sampled with plots at Sleeping Bear Dunes NL.

Sleeping Bear Dunes National Lakeshore Map Code: FCS

Local Description Authors: NA

Global Description Authors: J. Drake

References: Chambers et al. 1997, Chapman et al. 1989, Clausen 1957, Greenall 1996, Harris et al. 1996, MNNHP 1993, Midwestern Ecology Working Group n.d., Schwintzer 1981, Schwintzer and Tomberlin 1982, Sims et al. 1989, Van Deelen 1999, WNHIP unpubl. data, Wanek and Newman 1976

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2. Shrubland & Grassland

2.C.1. Temperate Grassland, Meadow & Shrubland

2.C.1.Nc. Eastern North American Grassland, Meadow & Shrubland

M163. Eastern North American Prairie & Barrens

G063. Northern & Central Sand Barrens Group

Bracken Grassland

***Pteridium aquilinum* - *Bromus kalmii* Herbaceous Vegetation**
Bracken Fern - Kalm's Brome Herbaceous Vegetation
Identifier: CEGL005142

NVC CLASSIFICATION

Division	Eastern North American Grassland, Meadow & Shrubland (2.C.1.Nc)
Macrogroup	Eastern North American Prairie & Barrens (M163)
Group	Northern & Central Sand Barrens Group (G063)
Association (Common name)	Bracken Grassland
Ecological System(s):	Laurentian Pine-Oak Barrens (CES201.718)

ELEMENT CONCEPT

Global Summary: This bracken grassland community is found in the northern Great Lakes region of the United States and adjacent Canada. Stands occur on level plains or rolling uplands and in depressions ("frost pockets") in pitted outwash topography. Soils range from loams to fine sands, and are somewhat acidic (pH 4.6). Soil characteristics vary depending on the age of the stand. Soil drainage is generally good. The vegetation is dominated by ferns and grasses. *Pteridium aquilinum* (western brackenfern) may form an almost continuous canopy of fronds. Grass dominants include *Elymus trachycaulus* (slender wheatgrass), *Bromus kalmii* (arctic brome), *Danthonia spicata* (poverty oatgrass), *Oryzopsis asperifolia* (roughleaf ricegrass), and *Poa compressa* (Canada bluegrass). Forbs of high constancy include *Anaphalis margaritacea* (western pearly everlasting), *Symphyotrichum ciliolatum* (Lindley's aster), *Fragaria virginiana* (Virginia strawberry), and *Solidago nemoralis* (gray goldenrod). Dwarf-shrubs include *Comptonia peregrina* (sweet fern) and *Vaccinium angustifolium* (lowbush blueberry). A high number of exotic or weedy species are present, including *Hieracium aurantiacum* (orange hawkweed), *Lactuca serriola* (prickly lettuce), *Phleum pratense* (timothy), *Poa compressa* (Canada bluegrass), *Poa pratensis* (Kentucky bluegrass), *Rumex acetosella* (common sheep sorrel), and *Verbascum thapsus* (common mullein).

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This bracken grassland community was sampled once in the park. The site is a moderate southwest-facing beach ridge with rapidly drained sand soil. The ground surface is dominated by mosses and lichens (70% cover) with some leaf litter (20%), wood (4%) and dead plant stems (6%). Evidence of disturbance includes past logging (about 100+ years ago), past fire, and the presence of an old dump and exotic plants.
Global Environment: Stands occur on level plains or rolling uplands and in depressions ("frost pockets") in pitted outwash topography. Soils range from loams to fine sands and are somewhat acidic (pH 4.6). Soil characteristics vary depending on the age of the stand. Soil drainage is generally good (Curtis 1959).

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: This community is defined by the sparsely vegetated (10% cover) herbaceous layer of *Pteridium aquilinum* (western brackenfern). However, in this example, there is also a sparse (10%) tall-shrub layer (5-10 m tall) of *Prunus serotina* (black cherry) and sparse (10%) short-shrub layer (1-2 m) of *Acer rubrum* (red maple), *Dasiphora fruticosa* ssp. *floribunda* (shrubby-cinquefoil), *Juniperus communis* (common juniper), and *Quercus rubra* (northern red oak). Additional herbs include *Apocynum androsaemifolium* (spreading dogbane), *Carex eburnea* (bristleleaf sedge), *Fragaria virginiana* (Virginia strawberry), *Sporobolus cryptandrus* (sand dropseed), and exotics *Centaurea biebersteinii* (spotted knapweed), *Hypericum perforatum* (common St. Johnswort), and *Poa compressa* (Canada bluegrass). Nonvascular species cover 70% of the ground surface and include *Cladonia* (cup lichen) spp. (lichens) and *Sphagnum* (sphagnum) spp. (mosses).
Global Vegetation: The vegetation is dominated by ferns and grasses. *Pteridium aquilinum* (western brackenfern) may form an almost continuous canopy of fronds. Grass dominants include *Elymus trachycaulus* (slender wheatgrass), *Bromus kalmii* (arctic brome), *Danthonia spicata* (poverty oatgrass), *Oryzopsis asperifolia* (roughleaf ricegrass), and *Poa compressa* (Canada bluegrass). Forbs of high constancy include *Anaphalis margaritacea* (western pearly everlasting), *Symphyotrichum ciliolatum* (Lindley's aster), *Fragaria virginiana* (Virginia strawberry), and *Solidago nemoralis* (gray goldenrod). Dwarf-shrubs include *Comptonia peregrina* (sweet fern) and *Vaccinium angustifolium* (lowbush blueberry). A high number of exotic or weedy species are present, including *Hieracium aurantiacum* (orange hawkweed), *Lactuca serriola* (prickly lettuce), *Phleum pratense* (timothy), *Poa compressa* (Canada bluegrass), *Poa pratensis* (Kentucky bluegrass), *Rumex acetosella* (common sheep sorrel), and *Verbascum thapsus* (common mullein) (Curtis 1959).

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MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Prunus serotina* (black cherry)
Herb (field)	Fern or fern ally	*Pteridium aquilinum* (western brackenfern)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Prunus serotina* (black cherry), *Pteridium aquilinum* (western brackenfern)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Centaurea biebersteinii* (spotted knapweed, exotic, High/Medium), *Hypericum perforatum* (common St. Johnswort, exotic, High/Medium), *Poa compressa* (Canada bluegrass, exotic, High/Low)
Global: Exotic/Invasive: *Lactuca serriola* (prickly lettuce, exotic, Low/Insignificant), *Phleum pratense* (timothy, exotic, Medium), *Poa compressa* (Canada bluegrass, exotic, High/Low), *Rumex acetosella* (common sheep sorrel, exotic, Medium/Low), *Verbascum thapsus* (common mullein, exotic, Medium)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (3-Oct-1996).

CLASSIFICATION

Classification Confidence: 2 - Moderate
Global Comments: This type may vary from natural to semi-natural, as most stands appear to have originated after clearcutting and intense burns of pine barrens, but some stands occur in frost pockets on pitted outwash plains. In Michigan this type has something of a natural analog in Dry Sand Prairies, *Schizachyrium scoparium - Danthonia spicata - Carex pensylvanica - (Viola pedata)* Herbaceous Vegetation (CEGL002318).
Global Similar Associations:
- *Schizachyrium scoparium - Carex tonsa* var. *rugosperma - Carex muehlenbergii - Lithospermum caroliniense - Opuntia humifusa* Herbaceous Vegetation (CEGL005099)--This has more of a prairie flora, but also contains a high number of exotics.
- *Schizachyrium scoparium - Danthonia spicata - Carex pensylvanica - (Viola pedata)* Herbaceous Vegetation (CEGL002318)--This has more of a prairie flora.

Global Related Concepts:
- Bracken Grassland (Curtis 1959) =
- Pine Barren (Chapman et al. 1989) B

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled north of Shalda Creek.
Global Range: This bracken grassland community type is found in the northern Great Lakes region of the United States and adjacent Canada, ranging from northern Wisconsin to Michigan and Ontario.
Nations: CA, US
States/Provinces: MI, NY, ON, QC:S4, WI
USFS Ecoregions (1994/95): 212Hb:CCP, 212Hi:CCC, 212Ho:CCC, 212Hw:CCC, 212Jj:CCP, 212Jk:CCC, 212Jm:CCC, 212Ka:CPP, 212:Oa:CCC, 221Bc:CCC
Federal Lands: NPS (Pictured Rocks, Saratoga, Sleeping Bear Dunes); USFS (Chequamegon, Chequamegon-Nicolet, Nicolet)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.78.
Sleeping Bear Dunes National Lakeshore Map Code: HBF
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Chapman et al. 1989, Curtis 1959, Midwestern Ecology Working Group n.d., NRCS 2004a, WNHIP unpubl. data

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2.C.3. Temperate & Boreal Scrub & Herb Coastal Vegetation

2.C.3.Na. Eastern North American Dune & Coastal Grassland & Shrubland

M176. Eastern North American Beach, Shoreline & Flat

G342. Eastern North American Lake Flat & Beach Group

Inland Freshwater Strand Beach

Inland Freshwater Strand Beach Sparse Vegetation
Inland Freshwater Strand Beach Sparse Vegetation
Identifier: CEGL002310

NVC CLASSIFICATION

Division	Eastern North American Dune & Coastal Grassland & Shrubland (2.C.3.Na)
Macrogroup	Eastern North American Beach, Shoreline & Flat (M176)
Group	Eastern North American Lake Flat & Beach Group (G342)
Association (Common name)	Inland Freshwater Strand Beach
Ecological System(s):	Laurentian-Acadian Lakeshore Beach (CES201.586)

ELEMENT CONCEPT

Global Summary: This freshwater inland lake beach occurs throughout the upper midwestern and northeastern United States and adjacent Canada. Stands may be most common on sandy outwash plains, where lakes are large enough to be affected by wave action or annual fluctuations in water level. Stands are found in the lower beach zone, which has submergent and floating-leaved aquatics tolerant of stranding. Species composition of this type needs to be described.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This freshwater inland lake beach vegetation was sampled once in the park at Bass Lake. The site is a gently sloping, west-facing, seasonally flooded beach with rapidly drained sand soil. This community forms a narrow band (10-20 m wide) surrounding the lake. The unvegetated surface is dominated by bare sand (80% cover) with some small rocks (1%), leaf litter (15%) and dead plant stems (10%). Evidence of disturbance includes fluctuations in water level and the presence of animal and human tracks.
Global Environment: Stands may be most common on sandy outwash plains (MNNHP 1993), presumably where lakes are large enough to be affected by wave action or annual fluctuations in water level.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: This sparsely vegetated beach community is comprised of a very sparse (5% cover) short-shrub layer (1-2 m tall) of *Cephalanthus occidentalis* (common buttonbush) and *Fraxinus nigra* (black ash) over a sparse (10%) herbaceous layer (0.5-1 m) dominated by *Panicum virgatum* (switchgrass) along with lesser amounts of *Asclepias incarnata* (swamp milkweed), *Cladium mariscoides* (smooth sawgrass), *Iris versicolor* (harlequin blueflag), *Lycopus uniflorus* (northern bugleweed), *Schoenoplectus acutus* (hardstem bulrush), *Schoenoplectus americanus* (chairmaker's bulrush), *Symphyotrichum lanceolatum* (white panicle aster), and *Teucrium canadense* (Canada germander).
Global Vegetation: The lower beach zone has submergent and floating-leaved aquatics tolerant of stranding (MNNHP 1993). The upper beach zone has both perennial graminoids tolerant of inundation and erosion and annual species. Species composition of this type needs to be described.

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Panicum virgatum* (switchgrass), *Schoenoplectus acutus* var. *acutus* (hardstem bulrush)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Asclepias incarnata* (swamp milkweed), *Panicum virgatum* (switchgrass), *Schoenoplectus acutus* var. *acutus* (hardstem bulrush), *Teucrium canadense* (Canada germander)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (3-Oct-1996).

CLASSIFICATION

Classification Confidence: 3 - Weak
Global Comments: Extent of this type in the region is not well known. Many inland lakes in the region do not have sparsely vegetated beaches.
Global Similar Associations:
- Lake Mudflats Sparse Vegetation (CEGL002313)

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Global Related Concepts:

- Lacustrine, Littoral, Unconsolidated Cobble/Gravel Shore, Intermittently Flooded (L2US1) (Cowardin et al. 1979) ?
- Lacustrine, Littoral, Unconsolidated Sand Shore, Intermittently Flooded (L2US2) (Cowardin et al. 1979) ?
- Lake Sand Beach (Thompson 1996) B
- Lakeshore Dry Shale Cobble Community (Thompson 1996) ?
- Lakeshore Sand Beach (Gawler 2002) B

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled at Bass Lake.
Global Range: This freshwater inland lake beach occurs locally throughout the upper midwestern and northeastern United States and adjacent Canada, ranging from Minnesota and Saskatchewan southeastward to Indiana and northeastward to Vermont and Ontario.
Nations: CA, US
States/Provinces: IN?, MB:S3S4, ME, MI, MN:S3, NY, ON, SK, VT, WI:S2
USFS Ecoregions (1994/95): 212Ha:CCP, 212Hb:CCP, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCP, 212Hk:CCP, 212Ho:CCC, 212Hq:CCP, 212Hw:CCC, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Jk:CPP, 212Jl:CPP, 212Jm:CPP, 212Jn:CPP, 212Jo:CPP, 212Jr:CPP, 212Ka:CCC, 212Mb:C??, 212Na:CPP, 212Nb:CPP, 212Nc:CPP, 212:Oa:CCC, 222:?
Federal Lands: NPS (Pictured Rocks, Sleeping Bear Dunes); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.74.
Sleeping Bear Dunes National Lakeshore Map Code: VAV
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Cowardin et al. 1979, Gawler 2002, Greenall 1996, MNNHP 1993, Midwestern Ecology Working Group n.d., Thompson 1996, Thompson and Sorenson 2000, WNHIP unpubl. data

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M057. Eastern North American Coastal Grassland & Shrubland

G089. Great Lakes Dune Grassland & Shrubland Group

Great Lakes Beachgrass Dune

***Ammophila breviligulata* - *(Schizachyrium scoparium)* Herbaceous Vegetation**
American Beachgrass - (Little Bluestem) Herbaceous Vegetation
Identifier: CEGL005098

NVC CLASSIFICATION

Division	Eastern North American Dune & Coastal Grassland & Shrubland (2.C.3.Na)
Macrogroup	Eastern North American Coastal Grassland & Shrubland (M057)
Group	Great Lakes Dune Grassland & Shrubland Group (G089)
Association (Common name)	Great Lakes Beachgrass Dune
Ecological System(s):	Great Lakes Dune (CES201.026)
	Great Lakes Wooded Dune and Swale (CES201.726)

ELEMENT CONCEPT

Global Summary: This beachgrass dune community occurs along the Great Lakes shores region of the United States and Canada on stabilized foredunes. Component plant communities vary from sparsely vegetated, active dunes to communities dominated by grasses, shrubs, and trees, depending on the degree of sand deposition, sand erosion, and distance from the lake. Depositional areas, where Great Lakes beachgrass foredunes are found, are dominated by *Ammophila breviligulata* (American beachgrass) (or in the eastern part of the range *Ammophila champlainensis* (Champlain beachgrass)); erosional areas, such as slacks in blowouts and dune fields, by *Calamovilfa longifolia* (prairie sandreed); and stabilized areas by *Schizachyrium scoparium* (little bluestem). In dune fields and on the most stable dune ridges, especially around northern Lake Michigan and Lake Huron, low evergreen shrubs (*Arctostaphylos uva-ursi* (kinnikinnick), *Juniperus communis* (common juniper), *Juniperus horizontalis* (creeping juniper)) occupy dune crests and also the ground layer in the savanna edge of dunes; elsewhere, deciduous shrubs are dominant, including *Prunus pumila* (sandcherry), *Salix cordata* (heartleaf willow) and *Salix myricoides* (bayberry willow). These two shrubby phases are separated from this open grassland type, but could be treated as phases of this type.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This common beachgrass dune community was sampled at 12 locations in the park. Sites range from flat to somewhat steep, mid- and lower slope dunes and dune ridges with north, northeast, northwest, southwest and southeast aspects. Soils are rapidly drained sand. The unvegetated surface is dominated by bare sand (20-95% cover) with some large rocks (0-60%), small rocks (0-40%), leaf litter (0-45%), wood (0-5%), dead plant stems (1-30%) and mosses (0-17%). Evidence of disturbance includes wind and wave erosion and the presence of invasive exotic plants.
Global Environment: Environmental processes include sand deposition, sand erosion, and stabilization. They are affected by the distance from the lake. Three sets of environmental habitats can be identified: depositional areas, erosional areas such as slacks in blowouts, and stabilized dune fields.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: This community is defined by the sparse to dense (20-80% cover) herbaceous layer of *Ammophila breviligulata* (American beachgrass). However, there may also be very sparse (5-10%) emergent tree (2-10 m) and/or shrub (0.5-2 m) layers that could include *Juniperus communis* (common juniper), *Populus deltoides* (eastern cottonwood), *Prunus pumila* (sandcherry), *Shepherdia canadensis* (russet buffaloberry), *Thuja occidentalis* (northern white-cedar), and others. *Arctostaphylos uva-ursi* (kinnikinnick), *Hudsonia tomentosa* (woolly beach-heather), and *Toxicodendron rydbergii* (western poison-ivy) may form a very sparse (<5%) dwarf-shrub layer. Additional herbs include *Artemisia campestris* (wormwood, field sagewort), *Asclepias syriaca* (common milkweed), *Calamovilfa longifolia* (prairie sandreed), *Equisetum hyemale* (scouringrush horsetail), *Festuca saximontana* (Rocky Mountain fescue), *Koeleria macrantha* (prairie Junegrass), *Lathyrus japonicus* (beach pea), *Lilium philadelphicum* (wood lily), *Lithospermum caroliniense* (Carolina puccoon), *Oenothera oakesiana* (Oakes' evening-primrose), *Pulsatilla patens* ssp. *multifida* (cutleaf anemone), *Schizachyrium scoparium* (little bluestem), *Solidago nemoralis* (gray goldenrod), *Zigadenus elegans* ssp. *glaucus* (mountain deathcamas), and others. Nonvascular species (mostly sphagnum mosses) cover 10-20% of the ground surface when present. This community has been invaded by several exotic species. However, it also supports Federally and state-listed threatened *Cirsium pitcheri* (Pitcher's thistle).
Global Vegetation: Component plant communities vary from sparsely vegetated, active dunes to communities dominated by grasses, shrubs, and trees, depending on the degree of sand deposition, sand erosion, and distance from the lake. Depositional areas, where Great Lakes beachgrass foredunes are found, are dominated by *Ammophila breviligulata; erosional areas, such as slacks in blowouts and dune fields, by Calamovilfa longifolia*; and stabilized areas by *Schizachyrium scoparium* (little bluestem). In dune fields and on the most stable dune ridges, especially around northern Lake Michigan and Huron, low evergreen shrubs (*Arctostaphylos uva-ursi* (kinnikinnick), *Juniperus communis* (common juniper), *Juniperus horizontalis* (creeping juniper)) occupy dune crests and also the ground layer in the savanna edge of dunes; elsewhere, deciduous shrubs are dominant, including *Prunus pumila* (sandcherry), *Salix cordata* (heartleaf willow) and *Salix myricoides* (bayberry willow). These two shrubby phases are separated from this open grassland type, but could be treated as phases of this type.

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MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Herb (field)	Forb	*Artemisia campestris* (wormwood, field sagewort), *Cirsium pitcheri* (Pitcher's thistle)
Herb (field)	Graminoid	*Ammophila breviligulata* (American beachgrass), *Schizachyrium scoparium* (little bluestem)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Ammophila breviligulata* (American beachgrass), *Artemisia campestris* (wormwood, field sagewort), *Calamovilfa longifolia* (prairie sandreed), *Cirsium pitcheri* (Pitcher's thistle), *Schizachyrium scoparium* (little bluestem)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Vulnerable: *Cirsium pitcheri* (Pitcher's thistle, Federally listed threatened, G3); **Exotic/Invasive**: *Centaurea biebersteinii* (spotted knapweed, exotic, High/Medium), *Epipactis helleborine* (broadleaf helleborine, exotic, Medium/Low), *Gypsophila paniculata* (babysbreath gypsophila, exotic, Medium/Low), *Populus nigra* (Lombardy poplar, exotic, Low/Insignificant), *Saponaria officinalis* (bouncingbet, exotic, Low/Insignificant), *Silene vulgaris* (maidenstears, exotic)
Global: Vulnerable: *Cirsium pitcheri* (Pitcher's thistle, Federally listed threatened; restricted to Great Lakes beach-grass/sparse foredunes and adjacent dune fields, G3)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G5 (3-Oct-1996).

CLASSIFICATION

Classification Confidence: 2 - Moderate
Global Comments: Perhaps 25-35% of Great Lakes dune species grow in maritime dunes (e.g., *Cakile edentula* (American searocket), *Ammophila breviligulata* (American beachgrass), *Hudsonia tomentosa* (woolly beach-heather), *Lathyrus japonicus* var. *maritimus* (beach pea)), but the many western species (such as *Schizachyrium scoparium* (little bluestem)) set Great Lakes dunes apart (as do its endemic plants, such as *Cirsium pitcheri* (Pitcher's thistle)). In Vermont (Lake Champlain) and New York (eastern Lake Ontario) the dunes apparently contain *Ammophila champlainensis* (Champlain beachgrass) instead of *Ammophila breviligulata* (American beachgrass). This type is linked in complexes with *Juniperus horizontalis - Arctostaphylos uva-ursi - Juniperus communis* Dune Dwarf-shrubland (CEGL005064) and *Prunus pumila - (Ptelea trifoliata*) Dune Shrubland (CEGL005075), which could be treated together as a single association, or treated as a complex open dune type. The sparsely vegetated parts of the dune are included in this association (old CEGL005161).
Global Similar Associations:
- *Cakile edentula* Great Lakes Shore Sparse Vegetation (CEGL005162)
- *Hudsonia tomentosa* Dune Dwarf-shrubland (CEGL004024)
- *Juniperus horizontalis - Arctostaphylos uva-ursi - Juniperus communis* Dune Dwarf-shrubland (CEGL005064)
- *Prunus pumila - (Ptelea trifoliata)* Dune Shrubland (CEGL005075)

Global Related Concepts:
- Lacustrine, Littoral, Unconsolidated Sand Shore, Intermittently Flooded (L2US2) (Cowardin et al. 1979) ?
- Lake Sand Beach (Thompson 1996) B
- Sand Dune Community (Thompson 1996) B

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along County Road 651, Dunes Trail and Cottonwood Trail, at Sleeping Bear Point and on North Manitou Island and South Manitou Island. It occurs widely on stabilized foredunes along the Lake Michigan shore and further inland on some of the perched dunes.
Global Range: This community occurs along the Great Lakes shores of the United States and Canada on stabilized foredunes, ranging from Wisconsin to Ontario and New York in the Great Lakes, and in isolated occurrences along the shores of Lake Champlain, Vermont.
Nations: CA, US
States/Provinces: IL, IN, MI, NY, ON, VT, WI:S2?
USFS Ecoregions (1994/95): 212Hd:CCC, 212He:CCC, 212Hi:CCC, 212Hj:CCC, 212Hl:CCC, 212Hm:CCP, 212Hn:CCC, 212Ho:CCC, 212Hr:CCP, 212Hw:CCC, 212Hx:CCC, 212Ia:CCC, 212Ja:CCC, 212Oa:CCC, 212Ob:CCC, 212Pa:CCC, 221E:CC, 222Ja:CCC, 222Jj:CCC, 222Kg:CCC
Federal Lands: NPS (Apostle Islands, Indiana Dunes, Pictured Rocks, Sleeping Bear Dunes); USFS (Hiawatha, Huron, Huron-Manistee?, Manistee?)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.2, SLBE.12, SLBE.35, SLBE.61, SLBE.63, SLBE.64, SLBE.65, SLBE.89, SLBE.92, SLBE.94, SLBE.115, SLBE.120.
Sleeping Bear Dunes National Lakeshore Map Code: HAB
Local Description Authors: M.J. Russo

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Global Description Authors: P. Comer

References: Cowardin et al. 1979, Farrand and Bell 1982, Midwestern Ecology Working Group n.d., Thompson 1996, Thompson and Sorenson 2000, WNHIP unpubl. data

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Great Lakes Beach

***Cakile edentula* Great Lakes Shore Sparse Vegetation**
American Searocket Great Lakes Shore Sparse Vegetation
Identifier: CEGL005162

NVC CLASSIFICATION

Division	Eastern North American Dune & Coastal Grassland & Shrubland (2.C.3.Na)
Macrogroup	Eastern North American Coastal Grassland & Shrubland (M057)
Group	Great Lakes Dune Grassland & Shrubland Group (G089)
Association (Common name)	Great Lakes Beach
Ecological System(s):	Great Lakes Dune (CES201.026)

ELEMENT CONCEPT

Global Summary: This community occurs along unstable shorelines in the Great Lakes region of the United States and Canada. Sites are severely affected by wind, waves, and winter ice. Easily shifted sand or gravel substrate permits little vegetation to develop, unless protected by a shoreline configuration that breaks waves and blocks winter ice. Soils are typically sands and gravels with little organic matter. *Cakile edentula* (American searocket), *Ammophila breviligulata* (American beachgrass), and *Salix myricoides* (bayberry willow) typically grow on sand beaches. Other common plant species include *Chamaesyce polygonifolia* (seaside sandmat), *Argentina anserina* (silverweed cinquefoil), *Salix* (willow) spp., *Schoenoplectus* (bulrush) spp., and *Xanthium strumarium* (rough cockleburr). A shrub zone (*Physocarpus opulifolius* (common ninebark), *Cornus sericea* (red-osier dogwood), *Rosa acicularis* (prickly rose), etc.) can develop at the inland margin of some gravel beaches. Species found on sand and gravel beaches in most cases are those of other shoreline habitats which gain a tenuous foothold on the beach.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This sea-rocket lakeshore sparse vegetation was sampled once in the park. The site is a gentle, north-facing beach with rapidly drained sand soil. The unvegetated surface is dominated by bare sand (85% cover) with some large rocks (1%), small rocks (1%), leaf litter (1%), wood (2%), zebra mussel shells (2%) and dead plant stems (10%). Evidence of disturbance includes the presence smut on dunegrass plants.
Global Environment: Sites occur along unstable shorelines of the Great Lakes. Easily shifted sand or gravel substrate permits little vegetation to develop, unless protected by a shoreline configuration that breaks waves and blocks winter ice. Soils are typically sands and gravels with little organic matter. The beach can include the sparsely vegetated parts of the upper beach, which is usually beyond the reach of the waves, and can form a type of sand plain.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The sparse (30% cover) herbaceous layer is dominated by *Ammophila breviligulata* (American beachgrass) and *Cakile edentula* (American searocket). Additional species found at trace amounts include *Elymus lanceolatus* (streambank wheatgrass), *Equisetum hyemale* (scouringrush horsetail), *Lathyrus japonicus* (beach pea), and Federally and state-listed threatened *Cirsium pitcheri* (Pitcher's thistle).
Global Vegetation: *Cakile edentula* (American searocket), *Ammophila breviligulata* (American beachgrass), and *Salix myricoides* (bayberry willow) typically grow on sand beaches. Other common plant species include *Chamaesyce polygonifolia* (seaside sandmat), *Argentina anserina* (silverweed cinquefoil), *Salix* (willow) spp., *Schoenoplectus* (bulrush) spp., and *Xanthium strumarium* (rough cockleburr). A shrub zone (*Physocarpus opulifolius* (common ninebark), *Cornus sericea* (red-osier dogwood), *Rosa acicularis* (prickly rose), etc.) can develop at the inland margin of some gravel beaches. Species found on sand and gravel beaches in most cases are those of other shoreline habitats which gain a tenuous foothold on the beach.

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Herb (field)	Forb	*Cakile edentula* (American searocket)
Herb (field)	Graminoid	*Ammophila breviligulata* (American beachgrass)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Ammophila breviligulata* (American beachgrass), *Cakile edentula* (American searocket)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Vulnerable: *Cirsium pitcheri* (Pitcher's thistle, Federally listed threatened, G3)
Global: Vulnerable: *Charadrius melodus* (piping plover, Federally listed endangered; use gravel beaches (esp. on islands) for nesting, G3), *Cirsium pitcheri* (Pitcher's thistle, Federally listed threatened, G3); **Other**: *Actitis macularius* (spotted sandpiper, beaches may be important during migration, G5), *Plectrophenax nivalis* (snow bunting, beaches may be important during migration, G5)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3? (22-Jun-1998). There may be fewer than 100 occurrences of this community rangewide (depending on how the boundaries of one occurrence are defined). This community is reported from Michigan (where it is ranked S3), Wisconsin

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(S2), Ohio (S1), Indiana (SU), Ontario (S2S3) and New York (S?). Currently 14 occurrences have been documented from Wisconsin, Illinois, and Ohio. There are probably fewer than 5,000 acres rangewide, since this community occurs in a narrow zone along the shores of the Great Lakes. Currently over 75 acres have been documented (average of documented sizes is 25 acres). This community has fairly narrow habitat requirements; it is restricted to sandy beaches along the Great Lakes that have active movement of sand controlled by water currents and wave action.

CLASSIFICATION

Classification Confidence: 1 - Strong

Global Comments: Stands occur on narrow shoreline-sand beaches. Some are associated with large dune systems. The beach can include the sparsely vegetated parts of the upper beach, which is usually beyond the reach of the waves, and can form sand flats. In Wisconsin this type is only on Lake Michigan. The *Cakile edentula* (American searocket) variety is primarily *lacustris*. Minnesota may have only a minor occurrence in the Duluth area.

Global Similar Associations:

- *Ammophila breviligulata - (Schizachyrium scoparium)* Herbaceous Vegetation (CEGL005098)
- *Cakile edentula* ssp. *edentula - Chamaesyce polygonifolia* Sparse Vegetation (CEGL004400)

Global Related Concepts:

- Beach Community (Anderson 1996) =

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled at Popples Campground.

Global Range: This community occurs along unstable shorelines in the Great Lakes region of the United States and Canada, ranging from sandy shores of all states and Ontario that are associated with the Great Lakes.

Nations: CA, US

States/Provinces: IL:S1, IN, MI, NY, OH, ON:S2S3, VT, WI:S2

USFS Ecoregions (1994/95): 212Hd:CCC, 212He:CCC, 212Hi:CCP, 212Hj:CCC, 212Ho:CCC, 212Hw:CCC, 212Ia:CPP, 212Ja:CPP, 212Oa:CCC, 212Ob:CCC, 222Ia:CCC, 222If:CCC, 222Jj:CCC, 222Kg:CCC, 222Qa:CCC

Federal Lands: NPS (Sleeping Bear Dunes); USFS (Hiawatha, Huron-Manistee, Huron?, Manistee)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.96.

Sleeping Bear Dunes National Lakeshore Map Code: VBO, VES

Local Description Authors: M.J. Russo

Global Description Authors: P. Comer

References: Anderson 1996, Midwestern Ecology Working Group n.d., WNHIP unpubl. data, White and Madany 1978

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Interdunal Wetland

Dasiphora fruticosa* ssp. *floribunda* / *Cladium mariscoides* - *Juncus balticus* - *(Rhynchospora capillacea)
Herbaceous Vegetation
Shrubby-cinquefoil / Smooth Sawgrass - Baltic Rush - (Needle Beaksedge) Herbaceous Vegetation
Identifier: CEGL005105

NVC CLASSIFICATION

Division	Eastern North American Dune & Coastal Grassland & Shrubland (2.C.3.Na)
Macrogroup	Eastern North American Coastal Grassland & Shrubland (M057)
Group	Great Lakes Dune Grassland & Shrubland Group (G089)
Association (Common name)	Interdunal Wetland
Ecological System(s):	Great Lakes Wooded Dune and Swale (CES201.726)
	Northern Great Lakes Interdunal Wetland (CES201.034)

ELEMENT CONCEPT

Global Summary: This interdunal wetland herbaceous community is found in dune systems of the southern (and perhaps northern) Great Lakes in the United States and Canada. Stands occur on the sandy soils of wet depressions in wind-deposited dune systems. The substrate is 75-100% sand. Organics and silts occur in small amounts in depressions of exposed dunelands, and in larger amounts in sheltered, inland wet depressions. Herbaceous vascular plants have <30% cover, trees and shrubs together have <30% cover, and trees alone have <5% cover. Several variants occur, correlating with depth to the mean annual water table (centers of swales versus highest portions of swales) and distance inland from the lakeshore (exposed duneland versus sheltered inland/duneland). The physiognomy and floristics of the herb-dominated intermediate zone of the swale are emphasized in this description, and include *Calamagrostis canadensis* (bluejoint), *Carex* (sedge) spp., *Cladium mariscoides* (smooth sawgrass), *Eleocharis quinqueflora* (fewflower spikerush), *Equisetum variegatum* (variegated scouringrush), *Juncus balticus* (Baltic rush), *Dichanthelium acuminatum* var. *fasciculatum* (western panicgrass), *Rhynchospora capillacea* (needle beaksedge), *Schoenoplectus acutus* (hardstem bulrush), and *Typha* (cattail) spp. Apart from the dominants, characteristic species include *Carex viridula* (little green sedge), *Oligoneuron ohioense* (Ohio goldenrod), *Hypericum kalmianum* (Kalm's St. Johnswort), *Panicum flexile* (wiry panicgrass), *Scleria verticillata* (low nutrush), *Lysimachia quadriflora* (fourflower yellow loosestrife), *Packera paupercula* (balsam groundsel), and *Eleocharis* (spikerush) spp. (including *Eleocharis quinqueflora* (fewflower spikerush)). *Rhynchospora capillacea* (needle beaksedge) is not in Ohio sites. Compositional changes take place if surrounding open dunes are stabilized and succeed to a forested condition.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This interdunal wetland herbaceous community was sampled at four locations in the park. The sites are intermittently to seasonally flooded flat to gently sloping, south-facing lakeplains and swales surrounding lakes. Soils are poorly drained to moderately well-drained sand. The unvegetated surface is dominated by leaf litter (14-85% cover) with some bare sand (0-5%), wood (0-1%), dead plant stems (5-10%), mosses and lichens (0-10%), algae (0-15%), marl crust with shells over sand (0-60%) and standing water (0-5%). Evidence of disturbance includes wind damage, water-level fluctuations, heavy deer browse, dry conditions due to drought, tree/shrub encroachment, signs of beaver activity, and the presence of exotic plants.

Global Environment: Interdunal wetlands are found on the sandy soils of wet depressions in wind-deposited dune systems of the Great Lakes. The depressions often form a sequence, with the youngest near the lake and older ones inland. Ontario occurrences of this same vegetative community have been recorded from moist, sandy substrates well inland. The substrate is 75-100% sand. Organics and silts occur in small amounts in depressions of exposed dunelands, and in larger amounts in sheltered, inland wet depressions. High concentrations of calcium, magnesium, and carbonate increase alkalinity and fertility. Phosphorus and important trace minerals, such as iron, manganese, zinc, copper, and cobalt, decrease when pH is above 7. Cation-exchange capacity is low. Occasionally, when located within active dune fields, these communities are buried by dune sand. Springs have been recorded to occur within interdunal wetland complexes, probably resulting from hydrological heads developed within adjacent dune ridges. These springs, when occurring on an occasional basis, set back succession within the wetland (Hiebert et al. 1986).

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: This community is defined by the dominance of *Cladium mariscoides* (smooth sawgrass) in the sparse to moderately dense (30-70% cover) herbaceous layer. However, there is also be a sparse (30%) shrub layer (0.5-1 m tall) of *Hypericum kalmianum* (Kalm's St. Johnswort); additional shrubs may include *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Alnus incana* ssp. *rugosa* (speckled alder), *Juniperus communis* (common juniper), *Pinus banksiana* (jack pine), *Prunus pumila* (sandcherry), *Rosa palustris* (swamp rose), *Rubus hispidus* (bristly dewberry), *Salix petiolaris* (meadow willow), and/or *Spiraea alba* (white meadowsweet). Additional graminoids may include *Calamagrostis canadensis* (bluejoint), *Calamagrostis stricta* ssp. *inexpansa* (northern reedgrass) (80% cover in one stand), *Carex viridula* (little green sedge), *Dichanthelium acuminatum* var. *fasciculatum* (western panicgrass), *Juncus balticus* (Baltic rush), *Muhlenbergia mexicana* (Mexican muhly), *Panicum virgatum* (switchgrass), and *Schoenoplectus americanus* (chairmaker's bulrush). Forbs may include *Argentina anserina* (silverweed cinquefoil), *Bidens connata* (purplestem beggarticks), *Eupatorium perfoliatum* (common boneset), *Euthamia graminifolia* (flat-top goldentop), *Iris versicolor* (harlequin blueflag), *Lobelia kalmii* (Ontario lobelia), *Lycopus uniflorus* (northern bugleweed), *Melampyrum lineare* (narrowleaf cowwheat), *Solidago canadensis* (Canada goldenrod), *Solidago rugosa* (wrinkleleaf goldenrod), *Symphyotrichum*

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lanceolatum (white panicle aster), and fern ally *Equisetum variegatum* (variegated scouringrush). Nonvascular species (mosses and lichens) cover <5% of the ground surface.

Global Vegetation: Herbaceous vascular plants have <30% cover, trees and shrubs together have <30% cover, and trees alone have <5% cover. Several variants of this community occur, correlating with depth to the mean annual water table (centers of swales versus highest portions of swales) and distance inland from the lakeshore (exposed duneland versus sheltered inland/duneland). The species composition of the community resembles alkaline shrub/herb fens, especially in the zone of groundwater emergence. The physiognomy and floristics of the herb-dominated intermediate zone of the swale are emphasized in this description and include *Calamagrostis canadensis* (bluejoint), *Carex* (sedge) spp., *Cladium mariscoides* (smooth sawgrass), *Eleocharis quinqueflora* (fewflower spikerush), *Equisetum variegatum* (variegated scouringrush), *Juncus balticus* (Baltic rush), *Dichanthelium acuminatum* var. *fasciculatum* (western panicgrass), *Rhynchospora capillacea* (needle beaksedge), *Schoenoplectus acutus* (hardstem bulrush), and *Typha* (cattail) spp. Apart from the dominants, characteristic species include *Carex viridula* (little green sedge), *Oligoneuron ohioense* (Ohio goldenrod), *Hypericum kalmianum* (Kalm's St. Johnswort), *Panicum flexile* (wiry panicgrass), *Scleria verticillata* (low nutrush), *Lysimachia quadriflora* (fourflower yellow loosestrife), *Packera paupercula* (balsam groundsel), *Eleocharis* (spikerush) spp. (including *Eleocharis quinqueflora* (fewflower spikerush)). *Rhynchospora capillacea* (needle beaksedge) is not in Ohio sites (White and Madany 1978, Homoya et al. 1985, Hiebert et al. 1986, Chapman et al. 1989).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved evergreen shrub	*Hypericum kalmianum* (Kalm's St. Johnswort)
Herb (field)	Graminoid	*Calamagrostis stricta* ssp. *inexpansa* (northern reedgrass), *Cladium mariscoides* (smooth sawgrass)

Global

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Calamagrostis canadensis* (bluejoint), *Cladium mariscoides* (smooth sawgrass), *Dichanthelium acuminatum* var. *fasciculatum* (western panicgrass), *Eleocharis quinqueflora* (fewflower spikerush), *Juncus balticus* (Baltic rush), *Rhynchospora capillacea* (needle beaksedge), *Schoenoplectus acutus* (hardstem bulrush)
Herb (field)	Fern or fern ally	*Equisetum variegatum* (variegated scouringrush)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Calamagrostis stricta* ssp. *inexpansa* (northern reedgrass), *Cladium mariscoides* (smooth sawgrass), *Hypericum kalmianum* (Kalm's St. Johnswort)

Global: *Cladium mariscoides* (smooth sawgrass), *Juncus balticus* (Baltic rush), *Rhynchospora capillacea* (needle beaksedge), *Triglochin maritima* (seaside arrowgrass

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Agrostis gigantea* (redtop, exotic, Medium/Low), *Tragopogon dubius* (yellow salsify, exotic, Medium/Low)

Global: Vulnerable: *Charadrius melodus* (piping plover, Federally listed endangered; may feed in the wet margins of this community, G3), *Oligoneuron houghtonii* (Houghton's goldenrod, Federally listed threatened; restricted to this community, it grows just above the average high water level where its roots contact the water table., G3); **Other**: *Acris crepitans* (northern cricket frog, may use this community during the spring breeding period, G5), *Bufo fowleri* (fowler's toad, may use this community during the spring breeding period, G5), *Bufo woodhousii* (woodhouse's toad, may use this community during the spring breeding period, G5)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3? (22-Jun-1998). The total number of occurrences is unknown. Thirty-six have been documented: 2 in Illinois (where the community is ranked S1), 6 in Indiana (S1), 23 in Michigan (S2), and 5 in Wisconsin (S1). No other occurrences have been documented, but the community also occurs in Ontario (S2,S1). It is found in 14 ecoregional subsections. Sizes of 29 occurrences range from 1 to 430 acres, totaling 1326. The community is found on the sandy soils (75-100% sand) of wet depressions in wind-deposited dune systems of the Great Lakes.

CLASSIFICATION

Classification Confidence: 2 - Moderate

Global Comments: This type may fit better under a *Dasiphora fruticosa* ssp. *floribunda* (shrubby-cinquefoil) saturated alliance (P. Comer pers. comm. 1997), where the shrub component may vary from low to as high as 50%. This range of this type is currently limited to the southern Great Lakes, but in Michigan this type could occur in northern Michigan, where it may be found as part of the Great Lakes Wooded Dune and Swale Complex (CECX005701). A number of the dominant and indicator species (*Cladium mariscoides* (smooth sawgrass), *Dasiphora fruticosa* ssp. *floribunda* (shrubby-cinquefoil), *Oligoneuron ohioense* (Ohio goldenrod)) are common in both the southern and northern wetlands, but stands in the south are often found with oak savanna and tallgrass prairie species on adjacent ridges, and thus have some compositional differences reflected in the wetlands (P. Comer pers. comm. 2000). It is also possible that *Calamagrostis canadensis - Carex viridula - Cladium mariscoides - Lobelia kalmii* Herbaceous Vegetation (CEGL005115) is the northern interdunal wetland equivalent.

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Global Similar Associations:
- *Calamagrostis canadensis - Carex viridula - Cladium mariscoides - Lobelia kalmii* Herbaceous Vegetation (CEGL005115)
- *Cladium mariscoides - (Carex lasiocarpa, Hypericum kalmianum, Oligoneuron riddellii, Eleocharis elliptica)* Herbaceous Vegetation (CEGL005104)
- *Cladium mariscoides - Carex cryptolepis - Rhynchospora alba - Juncus canadensis* Herbaceous Vegetation [Provisional] (CEGL005103)
- *Dasiphora fruticosa* ssp. *floribunda / Carex interior - Carex flava - Sarracenia purpurea* Shrub Herbaceous Vegetation (CEGL005140)
- *Dasiphora fruticosa* ssp. *floribunda / Carex sterilis - Andropogon gerardii - Arnoglossum plantagineum* Shrub Herbaceous Vegetation (CEGL005139)--is a rich fen.

Global Related Concepts:
- Palustrine (Cowardin et al. 1979) B

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled at the mouth of the Platte River (south dunes), at North Bar Lake and School Lake and on South Manitou Island (Florence Lake).
Global Range: This interdunal wetland herbaceous community is found in dune systems of the southern (and perhaps northern) Great Lakes in the United States and Canada, ranging from northern Illinois and Indiana, northward to Wisconsin, Michigan, and Ontario. Great Lakes shores include Lake Michigan, Lake Huron (not south of Saginaw Bay), Georgian Bay, and possibly Lake Erie.
Nations: CA, US
States/Provinces: IL:S1, IN:S1, MI:S2, ON, WI:S1
USFS Ecoregions (1994/95): 212Hd:CCC, 212Hj:CCC, 212Hl:CCC, 212Ho:CCC, 212Hr:CCC, 212Hw:CCC, 212Hx:CCC, 212Ia:CCC, 212Ja:CCP, 212Jb:CCC, 212Jn:CCC, 212Oa:CCC, 212Ob:CCC, 222Jj:CCC, 222Kg:CCC
Federal Lands: NPS (Indiana Dunes, Sleeping Bear Dunes); USFS (Huron-Manistee?, Huron?, Manistee?)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.41, SLBE.75, SLBE.82, SLBE.84.
Sleeping Bear Dunes National Lakeshore Map Code: HDW
Local Description Authors: M.J. Russo
Global Description Authors: J. Drake and D. Faber-Langendoen
References: Bakowsky 1990, Chapman et al. 1989, Cowardin et al. 1979, Hiebert et al. 1986, Homoya et al. 1985, Homoya et al. 1988, Midwestern Ecology Working Group n.d., Reznicek and Catling 1989, WNHIP unpubl. data, White and Madany 1978

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Great Lakes Juniper Dune Shrubland

***Juniperus horizontalis - Arctostaphylos uva-ursi - Juniperus communis* Dune Dwarf-shrubland**
Creeping Juniper - Kinnikinnick or Bearberry - Common Juniper Dune Dwarf-shrubland
Identifier: CEGL005064

NVC CLASSIFICATION

Division	Eastern North American Dune & Coastal Grassland & Shrubland (2.C.3.Na)
Macrogroup	Eastern North American Coastal Grassland & Shrubland (M057)
Group	Great Lakes Dune Grassland & Shrubland Group (G089)
Association (Common name)	Great Lakes Juniper Dune Shrubland
Ecological System(s):	Great Lakes Dune (CES201.026)
	Great Lakes Wooded Dune and Swale (CES201.726)

ELEMENT CONCEPT

Global Summary: This dwarf-shrub dune community is found throughout the western Great Lakes region of the United States and Canada. Stands are found on flat-topped, windswept, stabilized dunes. The dwarf-shrubs form an open to closed mat layer. Dominant shrubs include *Arctostaphylos uva-ursi* (kinnikinnick), *Juniperus communis* (common juniper), and *Juniperus horizontalis* (creeping juniper). *Hudsonia tomentosa* (woolly beach-heather) may also be present, along with a variety of other deciduous shrubs. *Ammophila breviligulata* (American beachgrass) and *Schizachyrium scoparium* (little bluestem) are among the herbaceous species found here.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This dwarf-shrub dune community was sampled at six locations in the park. Sites range from flat lakeplain depressions to the lower slopes of hills, dunes and moraines to a very steep, west-facing dune. Soils include moderately well-drained loamy sand and rapidly to well-drained sand. The unvegetated surface is made up of leaf litter (1-59% cover), large rocks (0-1%), small rocks (0-15%), bare sand (0-60%), wood (0-2%), dead plant stems (4-90%) and mosses and lichens (0-40%). Evidence of disturbance includes wind and wave erosion, dead standing trees and the presence of many exotic plants.
Global Environment: Stands are found on flat-topped, windswept, stabilized dunes.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: This association is dominated by a sparse to very dense (30-90% cover) dwarf-shrub layer of *Juniperus horizontalis* (creeping juniper) and *Arctostaphylos uva-ursi* (kinnikinnick). However, there may also be emergent tree layers (0.5-5+ m tall) that include *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Juniperus communis* (common juniper) (up to 50% cover), *Populus deltoides* (eastern cottonwood), *Populus tremuloides* (quaking aspen), *Prunus virginiana* (chokecherry), *Shepherdia canadensis* (russet buffaloberry), and others. The very sparse to spare (5-40%) herbaceous layer may be dominated by *Pteridium aquilinum* (western brackenfern) or *Schizachyrium scoparium* (little bluestem) and may include *Artemisia campestris* (wormwood, field sagewort), *Asclepias syriaca* (common milkweed), *Calamovilfa longifolia* (prairie sandreed), *Campanula rotundifolia* (bluebell bellflower), *Equisetum hyemale* (scouringrush horsetail), *Fragaria virginiana* (Virginia strawberry), *Koeleria macrantha* (prairie Junegrass), *Lithospermum caroliniense* (Carolina puccoon), *Minuartia michauxii* (Michaux's stitchwort), *Monarda punctata* (spotted beebalm), *Solidago simplex* (Mt. Albert goldenrod), *Zigadenus elegans* ssp. *glaucus* (mountain deathcamas), and others. Nonvascular species (mosses and lichens), when present, can cover up to 40% of the ground surface. This community has been invaded by many exotic species. However, it also supports Federally and state-listed threatened *Cirsium pitcheri* (Pitcher's thistle).
Global Vegetation: The dwarf-shrubs form an open to closed mat layer. Dominant shrubs include *Arctostaphylos uva-ursi* (kinnikinnick), *Juniperus communis* (common juniper), and *Juniperus horizontalis* (creeping juniper). *Hudsonia tomentosa* (woolly beach-heather) may also be present, along with a variety of other deciduous shrubs. *Ammophila breviligulata* (American beachgrass) and *Schizachyrium scoparium* (little bluestem) are among the herbaceous species found here (Curtis 1959, especially plates 61 and 62, White and Madany 1978, Bakowsky and Lee 1996).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Short shrub/sapling	Needle-leaved shrub	*Juniperus communis* (common juniper)
Herb (field)	Dwarf-shrub	*Arctostaphylos uva-ursi* (kinnikinnick), *Juniperus horizontalis* (creeping juniper)
Herb (field)	Graminoid	*Schizachyrium scoparium* (little bluestem)
Herb (field)	Fern or fern ally	*Pteridium aquilinum* (western brackenfern)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Arctostaphylos uva-ursi* (kinnikinnick), *Artemisia campestris* (wormwood, field sagewort), *Juniperus communis* (common juniper), *Juniperus horizontalis* (creeping juniper), *Koeleria macrantha* (prairie Junegrass), *Pteridium aquilinum* (western brackenfern), *Schizachyrium scoparium* (little bluestem)

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OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Vulnerable: *Cirsium pitcheri* (Pitcher's thistle, Federally listed threatened, G3); **Exotic/Invasive**: *Centaurea biebersteinii* (spotted knapweed, exotic, High/Medium), *Dianthus deltoides* (maiden pink, exotic, Low/Insignificant), *Epipactis helleborine* (broadleaf helleborine, exotic, Medium/Low), *Hypericum perforatum* (common St. Johnswort, exotic, High/Medium), *Malus pumila* (paradise apple, exotic, Medium/Insignificant), *Poa compressa* (Canada bluegrass, exotic, High/Low), *Silene vulgaris* (maidenstears, exotic)
Global: Vulnerable: *Cirsium pitcheri* (Pitcher's thistle, Federally listed threatened, G3)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (24-Oct-2002). This dwarf-shrub dune community has a moderately wide range, being found throughout dune areas of the western Great Lakes region of the United States and Canada. But the dune habitat, per se, is of very limited area. Few Element Occurrences have been documented for this type, partly because it has often been treated as part of a larger dune grassland type. Sites where the type is expected are often under some form of protection. The type is susceptible to natural or human-caused disturbances that may cause dune "blow-outs."

CLASSIFICATION

Classification Confidence: 2 - Moderate
Global Comments: Type is dominated by evergreen shrubs. Deciduous stands dominated by willows are placed in *Prunus pumila - (Ptelea trifoliata)* Dune Shrubland (CEGL005075). This type may be a minor component of other vegetation types, such as *Ammophila breviligulata - (Schizachyrium scoparium)* Herbaceous Vegetation (CEGL005098), or the Great Lakes Pine Barrens, *Pinus banksiana - (Pinus resinosa) - Pinus strobus / Juniperus horizontalis* Wooded Herbaceous Vegetation (CEGL005125), and it could conceivably be treated as a phase of CEGL005098.
Global Similar Associations:
- *Ammophila breviligulata - (Schizachyrium scoparium)* Herbaceous Vegetation (CEGL005098)
- *Hudsonia tomentosa* Dune Dwarf-shrubland (CEGL004024)
- *Pinus banksiana - (Pinus resinosa) - Pinus strobus / Juniperus horizontalis* Wooded Herbaceous Vegetation (CEGL005125)
- *Prunus pumila - (Ptelea trifoliata)* Dune Shrubland (CEGL005075)

Global Related Concepts:
- Open Dune (Chapman et al. 1989) B

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Good Harbor Bay Trail, at Sleeping Bear Point and on South Manitou Island and North Manitou Island.
Global Range: This dwarf-shrub dune community is found throughout dune areas of the western Great Lakes region of the United States and Canada, ranging from the shores of southern Michigan in Illinois, Indiana and Michigan northward to the shores of other Great Lakes, such as Lake Superior in Wisconsin.
Nations: CA, US
States/Provinces: IL, IN?, MI, ON:S2, WI
USFS Ecoregions (1994/95): 212Hi:CCC, 212Ho:CCC, 212Hw:CCC, 212Ia:CCC, 212Ja:CCP, 212:Oa:CCC, 222Kg:CCP
Federal Lands: NPS (Apostle Islands, Pictured Rocks, Sleeping Bear Dunes)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.7, SLBE.34, SLBE.37, SLBE.100, SLBE.117, SLBE.119.
Sleeping Bear Dunes National Lakeshore Map Code: DJD
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Bakowsky and Lee 1996, Chapman et al. 1989, Curtis 1959, Farrand and Bell 1982, Midwestern Ecology Working Group n.d., WNHIP unpubl. data, White and Madany 1978

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Great Lakes Coast Pine Barrens

***Pinus banksiana - (Pinus resinosa) - Pinus strobus / Juniperus horizontalis* Wooded Herbaceous Vegetation**
Jack Pine - (Red Pine) - Eastern White Pine / Creeping Juniper Wooded Herbaceous Vegetation
Identifier: CEGL005125

NVC CLASSIFICATION

Division	Eastern North American Dune & Coastal Grassland & Shrubland (2.C.3.Na)
Macrogroup	Eastern North American Coastal Grassland & Shrubland (M057)
Group	Great Lakes Dune Grassland & Shrubland Group (G089)
Association (Common name)	Great Lakes Coast Pine Barrens
Ecological System(s):	Great Lakes Wooded Dune and Swale (CES201.726)

ELEMENT CONCEPT

Global Summary: This pine barrens type is found in sandy areas along the Great Lakes shores of the United States and Canada. Stands occur on sands on former lake embayments and on some dune-and-swale complexes along the shores of the Great Lakes. Soils are circumneutral dry sands. Where this community occurs as part of a dune-and-swale complex it is found on the slopes and ridges of the dunes. The vegetation forms a coniferous savanna of scattered and clumped trees. Patches of bare sand are common. In the tree layer, *Pinus banksiana* (jack pine) is usually the single most abundant tree, but several other species, including *Pinus resinosa* (red pine) and *Pinus strobus* (eastern white pine) are typically present. Much of the shrub layer is composed of evergreen species, namely *Arctostaphylos uva-ursi* (kinnikinnick), *Hudsonia tomentosa* (woolly beach-heather), *Juniperus horizontalis* (creeping juniper), *Juniperus communis* (common juniper), and *Vaccinium angustifolium* (lowbush blueberry). The most abundant species of the ground layer include *Agrostis hyemalis* (winter bentgrass), *Arabis lyrata* (lyrate rockcress), *Ammophila breviligulata* (American beachgrass), *Calamovilfa longifolia* (prairie sandreed), *Danthonia spicata* (poverty oatgrass), *Deschampsia flexuosa* (wavy hairgrass), and *Toxicodendron radicans* (eastern poison-ivy). In dune-swale complexes, the swales between the dunes are often close enough to the water table to support more mesophytic, sometimes even semi-aquatic, plants. Along the shores of the Great Lakes there is often a dense low or creeping shrub layer.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This jack pine wooded herbaceous vegetation was sampled at four locations in the park. Sites are flat to gently rolling dunes with rapidly to well-drained sand soils. This community forms a narrow band between beach communities and mixed pine-deciduous dune forests. The unvegetated surface is dominated by bare sand (10-85% cover) with some small rocks (0-2%), leaf litter (5-40%), wood (0-5%) dead plant stems (5-10%) and mosses and lichens (0-40%). Evidence of disturbance includes wind erosion, dead standing and fallen trees and the presence of exotic plants.
Global Environment: This community occurs on sandy former lake embayments and on some dune and swale complexes along the shores of the Great Lakes. Changes in the lake water levels periodically raises the water table. Soils are circumneutral (pH 6.6-7.3) dry sands (Chapman et al. 1989).

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The sparse (10-40% cover) tree canopy, 5-10 m tall, and very sparse to moderate (5-30%) tall-shrub layer (2-5 m) are dominated exclusively by *Pinus banksiana* (jack pine). The very sparse (5-10%) short-shrub layer (0.5-2 m) may include *Hypericum kalmianum* (Kalm's St. Johnswort), *Juniperus communis* (common juniper), *Pinus banksiana* (jack pine), *Prunus pumila* (sandcherry), *Salix eriocephala* (Missouri River willow), *Salix myricoides* (bayberry willow), *Shepherdia canadensis* (russet buffaloberry), and/or *Thuja occidentalis* (northern white-cedar). *Arctostaphylos uva-ursi* (kinnikinnick) forms a very sparse to moderately dense (5-70%) dwarf-shrub layer along with lesser amounts of *Hudsonia tomentosa* (woolly beach-heather) and *Juniperus horizontalis* (creeping juniper). The very sparse to moderately sparse (5-40%) herbaceous layer includes *Artemisia campestris* (wormwood, field sagewort), *Calamovilfa longifolia* (prairie sandreed), *Campanula rotundifolia* (bluebell bellflower), *Juncus balticus* (Baltic rush), *Koeleria macrantha* (prairie Junegrass), *Panicum virgatum* (switchgrass), *Schizachyrium scoparium* (little bluestem), *Solidago nemoralis* (gray goldenrod), and others. Nonvascular species (sphagnum and other mosses and lichens), when present, cover up to 20% of the ground surface. In addition, this community supports Federally and state-listed threatened *Cirsium pitcheri* (Pitcher's thistle).
Global Vegetation: The vegetation forms a coniferous savanna of scattered and clumped trees. Patches of bare sand are common. In the tree layer, *Pinus banksiana* (jack pine) is usually the single most abundant tree, but several other species, including *Pinus resinosa* (red pine) and *Pinus strobus* (eastern white pine) are typically present. Much of the shrub layer is composed of evergreen species, namely *Arctostaphylos uva-ursi* (kinnikinnick), *Hudsonia tomentosa* (woolly beach-heather), *Juniperus horizontalis* (creeping juniper), *Juniperus communis* (common juniper), and *Vaccinium angustifolium* (lowbush blueberry). The most abundant species of the ground layer include *Ammophila breviligulata* (American beachgrass), *Agrostis hyemalis* (winter bentgrass), *Arabis lyrata* (lyrate rockcress), *Calamovilfa longifolia* (prairie sandreed), *Danthonia spicata* (poverty oatgrass), *Deschampsia flexuosa* (wavy hairgrass), and *Toxicodendron radicans* (eastern poison-ivy). In dune-swale complexes, the swales between the dunes are often close enough to the water table to support more mesophytic, sometimes even semi-aquatic, plants. Along the shores of the Great Lakes there is often a dense low or creeping shrub layer (Chapman et al. 1989). Stunted individuals of *Quercus rubra* (northern red oak) are present in stands in Keweenaw County, MI (Chapman et al. 1989).

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MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Pinus banksiana* (jack pine)
Herb (field)	Dwarf-shrub	*Arctostaphylos uva-ursi* (kinnikinnick), *Juniperus horizontalis* (creeping juniper)
Herb (field)	Graminoid	*Schizachyrium scoparium* (little bluestem)

Global

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus banksiana* (jack pine), *Pinus resinosa* (red pine), *Pinus strobus* (eastern white pine)
Shrub/sapling (tall & short)	Vine/Liana	*Toxicodendron radicans* (eastern poison-ivy)
Short shrub/sapling	Needle-leaved tree	*Juniperus communis* (common juniper)
Short shrub/sapling	Dwarf-shrub	*Arctostaphylos uva-ursi* (kinnikinnick), *Hudsonia tomentosa* (woolly beach-heather), *Juniperus horizontalis* (creeping juniper), *Linnaea borealis* (twinflower)
Herb (field)	Graminoid	*Ammophila breviligulata* (American beachgrass), *Calamovilfa longifolia* (prairie sandreed), *Danthonia spicata* (poverty oatgrass), *Deschampsia flexuosa* (wavy hairgrass), *Festuca saximontana* (Rocky Mountain fescue)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Arctostaphylos uva-ursi* (kinnikinnick), *Juniperus horizontalis* (creeping juniper), *Pinus banksiana* (jack pine), *Schizachyrium scoparium* (little bluestem)
Global: *Ammophila breviligulata* (American beachgrass), *Hudsonia tomentosa* (woolly beach-heather), *Juniperus horizontalis* (creeping juniper), *Pinus banksiana* (jack pine), *Pinus resinosa* (red pine), *Pinus strobus* (eastern white pine)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Vulnerable: *Cirsium pitcheri* (Pitcher's thistle, Federally listed threatened, G3);
Exotic/Invasive: *Centaurea biebersteinii* (spotted knapweed, exotic, High/Medium), *Euphorbia cyparissias* (cypress spurge, exotic, Medium/Low), *Gypsophila paniculata* (babysbreath gypsophila, exotic, Medium/Low), *Pinus sylvestris* (Scotch pine, exotic, Medium/Low), *Silene vulgaris* (maidenstears, exotic)
Global: Vulnerable: *Cirsium pitcheri* (Pitcher's thistle, Federally listed threatened; Herbaceous shoreline endemic of the western Great Lakes (Harrison 1988, Bowles et al. 1993). Has been found in this community in Michigan and has been studied by Bowles et al. (1993) in Illinois, G3)

CONSERVATION STATUS RANK

Global Rank & Reasons: G2 (22-Jun-1998). This community is restricted to the Great Lakes area and many sites have been degraded. Good occurrences are found on the Apostle Islands National Park, Wisconsin, and several others in Wisconsin could be restored (including several on Lake Michigan).

CLASSIFICATION

Classification Confidence: 1 - Strong
Global Comments: In Wisconsin, this type occurs in Lake Superior on the Apostle Islands. The physiognomy of the understory is complex, containing patches of shrub, dwarf-shrub, herbaceous, and sparse vegetation. The ground layer vegetation is somewhat related to the Great Lakes Juniper Dune Shrubland type, *Juniperus horizontalis - Arctostaphylos uva-ursi - Juniperus communis* Dune Dwarf-shrubland (CEGL005064). Several stands on Lake Michigan contain a number of prairie disjuncts (E. Epstein pers. comm. 1999).
Global Similar Associations:
- *Juniperus horizontalis - Arctostaphylos uva-ursi - Juniperus communis* Dune Dwarf-shrubland (CEGL005064)
- *Pinus banksiana - (Quercus ellipsoidalis) / Schizachyrium scoparium* - Prairie Forbs Wooded Herbaceous Vegetation (CEGL002490)
- *Pinus banksiana - Pinus resinosa - Pinus strobus* Dune Forest (CEGL002589)

Global Related Concepts:
- Great Lakes Barren (Chapman et al. 1989) B

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Lake Michigan Road, at Glen Haven and the mouth of the Platte River (south dunes) and on South Manitou Island (Lighthouse Dunes).
Global Range: This pine barrens type is found along sandy areas of the Great Lakes shores in the United States and Canada, including areas in Wisconsin, Michigan, and Ontario.
Nations: CA, US
States/Provinces: IN, MI, ON, WI:S1?

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USFS Ecoregions (1994/95): 212Hi:CCC, 212Hj:CCP, 212Ho:CCC, 212Hw:CCC, 212Ia:CCC, 212Ja:CPP, 212Jb:CP?, 212Jc:CP?, 212Jl:CP?, 212Jn:CP?, 212Oa:CCC, 222Jj:CCC

Federal Lands: NPS (Apostle Islands, Indiana Dunes, Pictured Rocks, Sleeping Bear Dunes); USFS (Hiawatha, Huron-Manistee, Huron?, Manistee)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.38, SLBE.48, SLBE.80, SLBE.90.

Sleeping Bear Dunes National Lakeshore Map Code: HPB, HPW

Local Description Authors: M.J. Russo

Global Description Authors: J. Drake and D. Faber-Langendoen

References: Bowles et al. 1993, Chapman et al. 1989, Harrison 1988, Midwestern Ecology Working Group n.d., WNHIP unpubl. data, Zimmerman 1956

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Cottonwood Woodland Alliance

***Populus deltoides* Woodland Alliance**
Eastern Cottonwood Woodland Alliance
Identifier: A.1493

NVC CLASSIFICATION

Division	Eastern North American Dune & Coastal Grassland & Shrubland (2.C.3.Na)
Macrogroup	Eastern North American Coastal Grassland & Shrubland (M057)
Group	Great Lakes Dune Grassland & Shrubland Group (G089)
Alliance (Common name)	Cottonwood Woodland
Ecological System(s):	Great Lakes Dune (CES201.026)
	Great Lakes Wooded Dune and Swale (CES201.726)

ELEMENT CONCEPT

Global Summary: This alliance is found on dune systems in the Great Lakes region of the United States and Canada. The canopy is very open, ranging from 5-25%, with little subcanopy or shrub layer. *Populus deltoides* is the dominant species, though *Tilia americana*, *Fraxinus pennsylvanica*, and other species may be present. The ground layer is dominated by exposed sand, with a scattered herbaceous layer. Typical associates include *Schizachyrium scoparium*, *Ammophila breviligulata*, *Sporobolus cryptandrus*, and *Poa compressa*.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This community is found on dunes near Lake Michigan. Slopes are typically low to moderate but stands of this community can occur near the top of steep slopes. Soils are sandy.
Global Environment:

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: Stands classified as the alliance level are dominated by a mixture of trees and shrubs that only rarely included *Populus deltoides*. Typical overstory dominants are *Tilia americana*, *Ostrya virginiana*, *Betula papyrifera*, *Fraxinus pennsylvanica*, *Prunus virginiana*, and *Acer saccharum*. The canopy ranges from open to moderately closed and is often short (<15 m tall). The understory is predominantly composed of typical dune species. Common shrubs include *Prunus* spp., *Juniperus communis*, *J. horizontalis*, *Cornus sericea*, *Toxicodendron rydbergii*, and *Vitis riparia*. Common herbaceous species include *Ammophila breviligulata*, *Maianthemum stellatum*, and *Pteridium aquilinum*.
Global Vegetation: This alliance is found on dune systems in the Great Lakes region of the United States and Canada. The canopy is very open, ranging from 5-25%, with little subcanopy or shrub layer. *Populus deltoides* is the dominant species, though *Tilia americana*, *Fraxinus pennsylvanica*, and other species may be present. The ground layer is dominated by exposed sand, with a scattered herbaceous layer. Typical associates include *Schizachyrium scoparium*, *Ammophila breviligulata*, *Sporobolus cryptandrus*, and *Poa compressa* (Bakowsky and Lee 1996).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Populus deltoides* (eastern cottonwood)
Herb (field)	Vine/Liana	*Toxicodendron rydbergii* (western poison-ivy), *Vitis riparia* (riverbank grape)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore:

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive:
Global: Other:

CONSERVATION STATUS RANK

Global Rank & Reasons:

CLASSIFICATION

Classification Confidence: 2 - Moderate
Global Comments:
Global Related Concepts:
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ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range:
Global Range: This community occurs in dune fields and on the most stable dune ridges in the southern Great Lakes region, especially around Lake Erie and Lake Ontario, ranging from Ohio and Ontario east to Pennsylvania, New York, and Vermont.
Nations: CA, US
States/Provinces: IN, MI, NY, OH, ON, PA, VT
USFS Ecoregions (1994/95): 212Ho:CCC, 212Hw:CCC, 212:Oa:CCC, 222Jj:CCC, 222Qa:CCC
Federal Lands: NPS (Indiana Dunes, Pictured Rocks, Sleeping Bear Dunes)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.AA0052, SLBE.AA235, SLBE.AA304, SLBE.AA314, SLBE.AA372, SLBE.AA0493, SLBE.AA501, SLBE.AA732, SLBE.AA924
Sleeping Bear Dunes National Lakeshore Map Code: WPB
Local Description Authors: J. Drake
Global Description Authors:
References:

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Cottonwood Dune Open Woodland

***Populus deltoides* - *(Juniperus virginiana)* Dune Woodland**
Eastern Cottonwood - (Eastern Red-cedar) Dune Woodland
Identifier: CEGL005119

NVC CLASSIFICATION

Division	Eastern North American Dune & Coastal Grassland & Shrubland (2.C.3.Na)
Macrogroup	Eastern North American Coastal Grassland & Shrubland (M057)
Group	Great Lakes Dune Grassland & Shrubland Group (G089)
Association (Common name)	Cottonwood Dune Open Woodland
Ecological System(s):	Great Lakes Dune (CES201.026)
	Great Lakes Wooded Dune and Swale (CES201.726)

ELEMENT CONCEPT

Global Summary: This community occurs in dune fields and on the most stable dune ridges in the southern Great Lakes region of the United States and Canada, especially around Lake Erie and Lake Ontario. The canopy is typically open (25-80% cover) and may even be scrubby due to wind damage. The most common dominant is *Populus deltoides* (eastern cottonwood), often in association with *Juniperus virginiana* (eastern red-cedar). *Quercus* (oak) spp. (including *Quercus macrocarpa* (bur oak), *Quercus rubra* (northern red oak), and *Quercus velutina* (black oak)) may occur, particularly when there are adjacent oak forests. Shrub and vine species include *Cornus drummondii* (roughleaf dogwood), *Parthenocissus quinquefolia* (Virginia creeper), *Rhus typhina* (staghorn sumac), *Salix amygdaloides* (peachleaf willow), *Salix exigua* (narrowleaf willow), *Salix fragilis* (crack willow), and *Vitis riparia* (riverbank grape). *Morella pensylvanica* (northern bayberry) is common at Presque Isle in Pennsylvania. Herbaceous species are scattered, but include *Asclepias syriaca* (common milkweed), *Elymus virginicus* (Virginia wildrye), *Rumex acetosella* (common sheep sorrel), *Schizachyrium scoparium* (little bluestem), and *Strophostyles helvula* (trailing fuzzybean).

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This cottonwood dune woodland was sampled once in the park. The site is located on a somewhat steep midslope of a dune and has rapidly drained sand soil. The unvegetated surface is dominated by leaf litter (90% cover) with some wood (5%) and dead plant stems (5%). Evidence of disturbance includes the presence of exotic plants.
Global Environment: This community occurs in dune fields and on the most stable dune ridges.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The moderate (60% cover) relatively stunted tree canopy, 5-10 m tall, is dominated by *Populus deltoides* (eastern cottonwood) with lesser amounts of *Betula papyrifera* (paper birch) also present. The very sparse (5%) tall-shrub layer (2-5 m) includes *Amelanchier laevis* (Allegheny serviceberry), *Betula papyrifera* (paper birch), *Fraxinus americana* (white ash), and *Prunus virginiana* (chokecherry). The moderate (60%) short-shrub layer (1-2 m) is codominated by *Cornus rugosa* (roundleaf dogwood), *Cornus sericea* (red-osier dogwood), and *Shepherdia canadensis* (russet buffaloberry). The dense (80%) herbaceous layer is dominated almost exclusively by *Toxicodendron rydbergii* (western poison-ivy). The vine *Vitis riparia* (riverbank grape), with up to 50% cover, climbs over the ground surface and up into the tall- and short-shrub layers.
Global Vegetation: The canopy is typically open (25-80% cover) and may even be scrubby due to wind damage. The most common dominant is *Populus deltoides* (eastern cottonwood), often in association with *Juniperus virginiana* (eastern red-cedar). *Quercus* (oak) spp. (including *Quercus macrocarpa* (bur oak), *Quercus rubra* (northern red oak), and *Quercus velutina* (black oak)) may occur, particularly when there are adjacent oak forests. Shrub and vine species include *Cornus drummondii* (roughleaf dogwood), *Parthenocissus quinquefolia* (Virginia creeper), *Rhus typhina* (staghorn sumac), *Salix amygdaloides* (peachleaf willow), *Salix exigua* (narrowleaf willow), *Salix fragilis* (crack willow), and *Vitis riparia* (riverbank grape). *Morella pensylvanica* (northern bayberry) is common at Presque Isle in Pennsylvania. Herbaceous species are scattered, but include *Asclepias syriaca* (common milkweed), *Elymus virginicus* (Virginia wildrye), *Rumex acetosella* (common sheep sorrel), *Schizachyrium scoparium* (little bluestem), and *Strophostyles helvula* (trailing fuzzybean) (Anderson 1996, Fike 1999).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Populus deltoides* (eastern cottonwood)
Herb (field)	Vine/Liana	*Toxicodendron rydbergii* (western poison-ivy), *Vitis riparia* (riverbank grape)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Cornus rugosa* (roundleaf dogwood), *Cornus sericea* ssp. *sericea* (red-osier dogwood), *Populus deltoides* (eastern cottonwood), *Shepherdia canadensis* (russet buffaloberry), *Toxicodendron rydbergii* (western poison-ivy), *Vitis riparia* (riverbank grape)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Lonicera tatarica* (Tatarian honeysuckle, exotic, High/Medium), *Poa compressa* (Canada bluegrass, exotic, High/Low), *Prunus mahaleb* (Mahaleb cherry, exotic, Medium/Insignificant)

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Global: Other: *Morella pensylvanica* (northern bayberry, was historically known from Ashtabula Co. dunes in Ohio (Anderson 1996), G5)

CONSERVATION STATUS RANK

Global Rank & Reasons: G1G2 (22-Jun-1998). There are probably fewer than 60 occurrences rangewide. Occurrences tend to be small, averaging less than 20 acres, so there is probably less than 1000 acres rangewide. This community is restricted to shores of the eastern Great Lakes and Lake Champlain. There has been a significant decline in occurrences due to residential development along the shores of the eastern Great Lakes and Lake Champlain. The community requires stabilized sand dunes along these large lakes.

CLASSIFICATION

Classification Confidence: 2 - Moderate
Global Comments: *Juniperus virginiana* (eastern red-cedar) may form enough of a dominant without *Populus deltoides* (eastern cottonwood) that it may deserve its own type (Lee et al. 1998).
Global Related Concepts:

- Sand Dune Community (Thompson 1996) B

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Dunes Trail.
Global Range: This community occurs in dune fields and on the most stable dune ridges in the southern Great Lakes region, especially around Lake Erie and Lake Ontario, ranging from Ohio and Ontario east to Pennsylvania, New York, and Vermont.
Nations: CA, US
States/Provinces: IN, MI, NY, OH, ON, PA, VT
USFS Ecoregions (1994/95): 212Ho:CCC, 212Hw:CCC, 212:Oa:CCC, 222Jj:CCC, 222Qa:CCC
Federal Lands: NPS (Indiana Dunes, Pictured Rocks, Sleeping Bear Dunes)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.62.
Sleeping Bear Dunes National Lakeshore Map Code: WCD
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Anderson 1996, Fike 1999, Lee et al. 1998, Midwestern Ecology Working Group n.d., Thompson 1996, Thompson and Sorenson 2000

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Sand Cherry Dune Shrubland

***Prunus pumila* - *(Ptelea trifoliata)* Dune Shrubland**
Sandcherry - (Common Hoptree) Dune Shrubland
Identifier: CEGL005075

NVC CLASSIFICATION

Division	Eastern North American Dune & Coastal Grassland & Shrubland (2.C.3.Na)
Macrogroup	Eastern North American Coastal Grassland & Shrubland (M057)
Group	Great Lakes Dune Grassland & Shrubland Group (G089)
Association (Common name)	Sand Cherry Dune Shrubland
Ecological System(s):	Great Lakes Dune (CES201.026)
	Great Lakes Wooded Dune and Swale (CES201.726)

ELEMENT CONCEPT

Global Summary: This shrub dune community is found on southern Great Lakes dunes or inland dune systems in the United States and Canada. Stands occur on stabilized foredunes. They are dominated by deciduous shrubs, with a relatively open canopy. *Prunus pumila* (sandcherry) is a characteristic dominant, but *Salix cordata* (heartleaf willow), *Salix myricoides* (bayberry willow), *Physocarpus opulifolius* (common ninebark), and *Ptelea trifoliata* (common hoptree) may also be present. The ground layer may consist of open sand with sparse herbaceous vegetation. Herbaceous species include *Ammophila breviligulata* (American beachgrass), *Schizachyrium scoparium* (little bluestem) and others.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This shrub dune community sampled once in the park. The site is located on rolling dunes with rapidly drained sand soil. The unvegetated surface is dominated by bare sand (90% cover) with some leaf litter (5%) and dead plant stems (5%). Evidence of disturbance includes heavy insect feeding damage and the presence of exotic plants.
Global Environment: Stands occur on stabilized foredunes.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: This is a sparsely vegetated short shrubland. The very sparse (10%) shrub layer (0.5-1 m) is dominated by *Salix myricoides* (bayberry willow) and includes lesser amounts of *Prunus pumila* (sandcherry) and *Salix eriocephala* (Missouri River willow). *Arctostaphylos uva-ursi* (kinnikinnick) and *Hudsonia tomentosa* (woolly beach-heather) form a very sparse (<5%) dwarf-shrub layer. The sparse (20%) herbaceous layer is codominated by *Gypsophila paniculata* (babysbreath gypsophila) (exotic) and *Schizachyrium scoparium* (little bluestem); additional herbs include *Ammophila breviligulata* (American beachgrass), *Artemisia campestris* (wormwood, field sagewort), *Lithospermum caroliniense* (Carolina puccoon), *Maianthemum stellatum* (starry false lily of the valley), *Solidago simplex* (Mt. Albert goldenrod), and *Zigadenus elegans* ssp. *glaucus* (mountain deathcamas). This community also supports Federally and state-listed threatened *Cirsium pitcheri* (Pitcher's thistle).
Global Vegetation: Stands are dominated by deciduous shrubs, with a relatively open canopy. *Prunus pumila* (sandcherry) is a characteristic dominant, but *Salix cordata* (heartleaf willow), *Salix myricoides* (bayberry willow), *Physocarpus opulifolius* (common ninebark), and *Ptelea trifoliata* (common hoptree) may also be present. The ground layer may consist of open sand with sparse herbaceous vegetation. Herbaceous species include *Ammophila breviligulata* (American beachgrass), *Schizachyrium scoparium* (little bluestem) and others (Chapman et al. 1989, Bakowsky and Lee 1996).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Salix myricoides* (bayberry willow)
Herb (field)	Graminoid	*Schizachyrium scoparium* (little bluestem)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Arctostaphylos uva-ursi* (kinnikinnick), *Prunus pumila* (sandcherry), *Salix myricoides* (bayberry willow), *Schizachyrium scoparium* (little bluestem)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Vulnerable: *Cirsium pitcheri* (Pitcher's thistle, Federally listed threatened, G3);
Exotic/Invasive: *Gypsophila paniculata* (babysbreath gypsophila, exotic, Medium/Low)
Global: Vulnerable: *Cirsium pitcheri* (Pitcher's thistle, Federally listed threatened, G3)

CONSERVATION STATUS RANK

Global Rank & Reasons: G2Q (22-Jun-1998). No occurrences have been documented, but the community is reported from Illinois, where it is ranked S1, Ontario (S?), and possibly Indiana (SP). It is found in 2 ecoregional sections. Stands are restricted to stabilized foredunes.

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CLASSIFICATION

Classification Confidence: 3 - Weak
Global Comments: Stands of this type are often intermingled with open grassland-dominated parts of the dune. This type may be of limited spatial extent, and there is some concern about the practicality of tracking it on a dynamic dune system. Inland dunes along the Illinois River may contain this type (B. McClain pers. comm. 1996). Lake dunes covered by *Juniperus horizontalis* (creeping juniper), *Juniperus communis* (common juniper), and/or *Arctostaphylos uva-ursi* (kinnikinnick) are placed in *Juniperus horizontalis - Arctostaphylos uva-ursi - Juniperus communis* Dune Dwarf-shrubland (CEGL005064).
Global Similar Associations:
- *Ammophila breviligulata - (Schizachyrium scoparium)* Herbaceous Vegetation (CEGL005098)
- *Hudsonia tomentosa* Dune Dwarf-shrubland (CEGL004024)
- *Juniperus horizontalis - Arctostaphylos uva-ursi - Juniperus communis* Dune Dwarf-shrubland (CEGL005064)

Global Related Concepts:
- Open Dune (Chapman et al. 1989) ?

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Old Indian Trail.
Global Range: This shrub dune community is found on southern Great Lakes dunes or inland dune systems in the United States and Canada, ranging from Wisconsin to Michigan and Ontario.
Nations: CA, US
States/Provinces: IL, IN, MI, ON, WI
USFS Ecoregions (1994/95): 212Hi:CCC, 212Ho:CCC, 212Hw:CCC, 212:Oa:CCC, 222Ja:CCC, 222Jj:CCC, 222K:C?
Federal Lands: NPS (Indiana Dunes, Pictured Rocks, Sleeping Bear Dunes)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.30.
Sleeping Bear Dunes National Lakeshore Map Code: SCW
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Bakowsky and Lee 1996, Chapman et al. 1989, Midwestern Ecology Working Group n.d., WNHIP unpubl. data

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2.C.4. Temperate & Boreal Bog & Fen

2.C.4.Na. North American Bog & Fen

M062. North American Boreal Bog & Fen

G386. Eastern North American Boreal Acidic Bog & Poor Fen Group

Leatherleaf Poor Fen

***Chamaedaphne calyculata / Carex oligosperma / Sphagnum* spp. Poor Fen Dwarf-shrubland**
Leatherleaf / Few-seed Sedge / Peatmoss species Poor Fen Dwarf-shrubland
Identifier: CEGL005277

NVC CLASSIFICATION

Division	North American Bog & Fen (2.C.4.Na)
Macrogroup	North American Boreal Bog & Fen (M062)
Group	Eastern North American Boreal Acidic Bog & Poor Fen Group (G386)
Association (Common name)	Leatherleaf Poor Fen
Ecological System(s):	Boreal-Laurentian Bog (CES103.581)
	Boreal-Laurentian-Acadian Acidic Basin Fen (CES201.583)
	Boreal-Laurentian Conifer Acidic Swamp and Treed Poor Fen (CES103.724)

ELEMENT CONCEPT

Global Summary: This dwarf-shrub poor fen community is found in the northern Great Lakes region and across much of central Canada. Sites are found on peatlands with low exposure to mineral-rich groundwater, including basin fens, shores above the level of seasonal flooding, and margins of larger peatlands. Stands have a saturated hydrology with a fibric *Sphagnum* (sphagnum) spp. peat soil and a pH usually <4.5. Vegetation is dominated by an open dwarf-shrub/scrub conifer layer with very scattered trees (<10% cover). Microtopography is high to intermediate hummocks with hollows or a flat lawn of *Sphagnum* (sphagnum) spp. Ericaceous dwarf-shrubs are dominant, including *Chamaedaphne calyculata* (leatherleaf), *Kalmia polifolia* (bog laurel), and *Ledum groenlandicum* (bog Labrador-tea), and the creeping dwarf-shrubs *Andromeda polifolia* (bog rosemary) and *Vaccinium oxycoccos* (small cranberry). *Betula pumila* (bog birch) has low cover but is fairly constant. Scrub conifers include *Larix laricina* (tamarack) and *Picea mariana* (black spruce). They also occur as scattered trees (>3 m). The herb layer is species-poor, containing *Carex oligosperma* (fewseed sedge), *Carex limosa* (mud sedge), *Equisetum fluviatile* (water horsetail), *Menyanthes trifoliata* (buckbean), *Sarracenia purpurea* (purple pitcherplant), and *Scheuchzeria palustris* (rannoch-rush). The moss layer forms a continuous hummocky mat dominated by *Sphagnum angustifolium* (sphagnum), *Sphagnum fuscum* (sphagnum), and *Sphagnum magellanicum* (Magellan's sphagnum). Diagnostic features include the dominance of a dwarf-shrub ericaceous layer, absence of a tree layer (<10%), species-poor herbaceous layer, and a low abundance of minerotrophic indicators, such as *Betula pumila* (bog birch), *Carex aquatilis* (water sedge) and *Carex stricta* (upright sedge).

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This leatherleaf dwarf-shrubland was sampled at three locations in the park. Sites are flat, intermittently to saturated depressions and lakeplains. Soils are very poorly to poorly drained peat. The ground surface is dominated by sphagnum mosses (55-90% cover) with some leaf litter (0-30%), wood (0-5%), bare soil (0-5%) and dead plant stems (5-15%). Evidence of disturbance includes abundant dead standing trees and very dry peatmoss likely due to changes in hydrology possibly from drought and/or beaver activity. Hazlett (1991) reports water depth at one site that was a meter deeper than it is now.

Global Environment: Sites are found on peatlands with low exposure to mineral-rich groundwater, including basin fens, shores above the level of seasonal flooding, and margins of larger peatlands. Stands have a saturated hydrology with a fibric *Sphagnum* (sphagnum) spp. peat soil and a pH usually <4.5 (Harris et al. 1996).

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The sparse to dense (20-80% cover) short-shrub layer (0.5-1 m) is dominated almost exclusively by *Chamaedaphne calyculata* (leatherleaf); additional shrubs may include *Betula papyrifera* (paper birch), *Ilex verticillata* (common winterberry), *Kalmia polifolia* (bog laurel), and *Photinia floribunda* (purple chokeberry). The very sparse (5-20%) dwarf-shrub layer may include *Andromeda polifolia* var. *glaucophylla* (bog rosemary), *Gaylussacia baccata* (black huckleberry), *Rubus hispidus* (bristly dewberry), *Vaccinium myrtilloides* (velvetleaf huckleberry), and *Vaccinium oxycoccos* (small cranberry). The very sparse to moderately dense (5-70%) herbaceous layer includes *Agrostis hyemalis* (winter bentgrass), *Carex* (sedge) spp., *Dulichium arundinaceum* (threeway sedge), *Eriophorum virginicum* (tawny cottongrass), *Juncus brevicaudatus* (narrowpanicle rush), *Juncus effusus* (common rush), *Menyanthes trifoliata* (buckbean), *Osmunda cinnamomea* (cinnamon fern), *Phalaris arundinacea* (reed canarygrass), *Scirpus cyperinus* (woolgrass), *Triadenum fraseri* (Fraser's marsh St. Johnswort), and insectivores *Drosera intermedia* (spoonleaf sundew) (newly reported for the park) and *Drosera rotundifolia* (roundleaf sundew); one stand has 60% cover of *Rhynchospora alba* (white beaksedge). Nonvascular species (sphagnum mosses) cover 50-90% of the ground surface. In addition, this community supports state-imperiled *Carex oligocarpa* (richwoods sedge).

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Global Vegetation: The vegetation is dominated by an open dwarf-shrub/scrub conifer layer with very scattered trees (<10% cover). Microtopography is high to intermediate hummocks with hollows or a flat lawn of *Sphagnum* (sphagnum) spp. Ericaceous dwarf-shrubs are dominant, including *Chamaedaphne calyculata* (leatherleaf), *Kalmia polifolia* (bog laurel), and *Ledum groenlandicum* (bog Labrador-tea), and the creeping dwarf-shrubs *Andromeda polifolia* (bog rosemary) and *Vaccinium oxycoccos* (small cranberry). *Betula pumila* (bog birch) has low cover but is fairly constant. Scrub conifers include *Larix laricina* (tamarack) and *Picea mariana* (black spruce). They also occur as scattered trees (>3 m). The herb layer is species-poor, containing *Carex oligosperma* (fewseed sedge), *Carex limosa* (mud sedge), *Equisetum fluviatile* (water horsetail), *Menyanthes trifoliata* (buckbean), *Sarracenia purpurea* (purple pitcherplant), and *Scheuchzeria palustris* (rannoch-rush). Minerotrophic indicators include *Carex aquatilis* (water sedge), *Carex rostrata* (beaked sedge), and *Carex stricta* (upright sedge). The moss layer forms a continuous hummocky mat dominated by *Sphagnum angustifolium* (sphagnum), *Sphagnum fuscum* (sphagnum), and *Sphagnum magellanicum* (Magellan's sphagnum) (Harris et al. 1996).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved evergreen shrub	*Chamaedaphne calyculata* (leatherleaf)
Herb (field)	Dwarf-shrub	*Vaccinium oxycoccos* (small cranberry)
Herb (field)	Graminoid	*Rhynchospora alba* (white beaksedge)
Herb (field)	Fern or fern ally	*Thelypteris palustris* (eastern marsh fern)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Chamaedaphne calyculata* (leatherleaf), *Photinia floribunda* (purple chokeberry), *Rhynchospora alba* (white beaksedge), *Thelypteris palustris* (eastern marsh fern), *Vaccinium oxycoccos* (small cranberry)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Vulnerable: *Carex oligocarpa* (richwoods sedge, state-imperiled, G4)

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (29-Mar-2000).

CLASSIFICATION

Classification Confidence: 2 - Moderate

Global Comments: It is difficult to distinguish this leatherleaf poor fen from leatherleaf bogs in the field, but conceptually this type has somewhat more minerotrophic influence and a corresponding set of minerotrophic indicators. When minerotrophic indicators are absent or "very low", the type is placed in *Chamaedaphne calyculata - Ledum groenlandicum - Kalmia polifolia* Bog Dwarf-shrubland (CEGL005278) (Harris et al. 1996). Stands with sparse black spruce-tamarack layer (<10% tree cover) are part of this type. Stands with 10-25% black spruce and tamarack cover are placed in black spruce/leatherleaf semi-treed bog, *Picea mariana / Chamaedaphne calyculata / Sphagnum* spp. Dwarf-shrubland (CEGL005218). This type also overlaps closely with a "scrubby poor fen type" *Larix laricina / Chamaedaphne calyculata / Carex lasiocarpa* Shrubland (CEGL005226). There are intermediates between this poor fen and sedge meadows, such as when *Sphagnum* (sphagnum) spp. and *Chamaedaphne calyculata* (leatherleaf) have invaded a *Carex rostrata* (beaked sedge) meadow and the *Carex rostrata* (beaked sedge) is hanging on because it still has deep rooting in the underlying minerotrophic peat or mineral soil (N. Aaseng pers. comm. 2000).

Global Similar Associations:

- *Betula pumila / Chamaedaphne calyculata / Carex lasiocarpa* Shrubland (CEGL002494)
- *Carex oligosperma - Carex pauciflora - Eriophorum vaginatum / Sphagnum* spp. Herbaceous Vegetation (CEGL005256)
- *Chamaedaphne calyculata - Ledum groenlandicum - Kalmia polifolia* Bog Dwarf-shrubland (CEGL005278)
- *Chamaedaphne calyculata - Myrica gale / Carex lasiocarpa* Dwarf-shrubland (CEGL005228)
- *Chamaedaphne calyculata / Carex oligosperma - Eriophorum virginicum* Dwarf-shrubland (CEGL005092)
- *Chamaedaphne calyculata / Carex oligosperma / Sphagnum* spp. Dwarf-shrubland (CEGL005091)--This type can form in seepy areas of "burned out" bogs.
- *Chamaedaphne calyculata / Eriophorum virginicum / Sphagnum rubellum* Dwarf-shrubland (CEGL006513)
- *Picea mariana / Chamaedaphne calyculata / Sphagnum* spp. Dwarf-shrubland (CEGL005218)--This type is a leatherleaf bog with a scattered tree layer (10-25%), or muskeg.

Global Related Concepts:

- Poor fen: black spruce - tamarack / ericaceous shrub / Sphagnum (W22) (Harris et al. 1996) F
- Poor fen: ericaceous shrub / Sphagnum (W21) (Harris et al. 1996) F

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Kelderhouse Road, at Bow Lakes (South Bog) and east of Oneda Farm.

Global Range: This dwarf-shrub poor fen community is found in the northern Great Lakes region and across much of central Canada, ranging from the eastern lake states west to Minnesota, and northward from Quebec to Manitoba and other parts of Canada.

Nations: CA, US

States/Provinces: MI, MN:S4, ON, QC:S3S4, WI:S4

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USFS Ecoregions (1994/95): 212Hi:CCC, 212Ho:CCC, 212Hw:CCC, 212Ia:CCC, 212J:CC, 212K:CC, 212L:CC, 212M:CP, 212N:CP, 212O:CC, 212:Oa:CCC, 212P:CC, 222J:C?, 222K:C?

Federal Lands: NPS (Apostle Islands, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Hiawatha, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa, Superior)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.18, SLBE.66, SLBE.72.

Sleeping Bear Dunes National Lakeshore Map Code: DLF

Local Description Authors: M.J. Russo

Global Description Authors: D. Faber-Langendoen

References: Harris et al. 1996, MNNHP 1993, Midwestern Ecology Working Group n.d., WNHIP unpubl. data

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G185. Eastern North American Boreal Alkaline Fen Group

Great Lakes Sedge Rich Shore Fen

***Calamagrostis canadensis - Carex viridula - Cladium mariscoides - Lobelia kalmii* Herbaceous Vegetation**
Bluejoint - Little Green Sedge - Smooth Sawgrass - Ontario Lobelia Herbaceous Vegetation
Identifier: CEGL005115

NVC CLASSIFICATION

Division	North American Bog & Fen (2.C.4.Na)
Macrogroup	North American Boreal Bog & Fen (M062)
Group	Eastern North American Boreal Alkaline Fen Group (G185)
Association (Common name)	Great Lakes Sedge Rich Shore Fen
Ecological System(s):	Great Lakes Alkaline Rocky Shore and Cliff (CES201.995)
	Great Lakes Freshwater Estuary and Delta (CES202.033)
	Northern Great Lakes Coastal Marsh (CES201.722)

ELEMENT CONCEPT

Global Summary: This community is typically found on marly coastal sites in northern Lake Michigan, Lake Huron, and Lake Superior in the United States. These sites occupy embayments of open, sandy shorelines where limestone bedrock or cobble is at or near the surface. These sites have calcareous soils (with a pH as high as 8.2), resulting either from calcareous substrates, waterflow off adjacent limestone bedrock or limestone-rich till, or algal precipitation of calcium carbonate in the relatively warm, carbonate-saturated waters. These 'marly flats' contain a rich assemblage of calciphilic plants. Herbaceous species dominate parts of these areas. The dominant graminoid is *Calamagrostis canadensis* (bluejoint), but *Carex viridula* (little green sedge) and *Lobelia kalmii* (Ontario lobelia) are key diagnostics of this type. Other diagnostic species include *Cladium mariscoides* (smooth sawgrass), *Hypericum kalmianum* (Kalm's St. Johnswort), *Dichanthelium acuminatum* var. *lindheimeri* (Lindheimer panicgrass), *Argentina anserina* (silverweed cinquefoil), and *Triglochin maritima* (seaside arrowgrass). Scattered shrubs, such as *Dasiphora fruticosa* ssp. *floribunda* (shrubby-cinquefoil) or *Myrica gale* (sweetgale) may be present, but shrub cover is less than 25%. In Wisconsin, in coastal estuaries of Lake Superior, common associates include *Cladium mariscoides* (smooth sawgrass), *Carex livida* (livid sedge), and *Triglochin maritima* (seaside arrowgrass). *Carex exilis* (coastal sedge) is codominant at several sites. On Isle Royale, sedges dominate the vegetation. *Cladium mariscoides* (smooth sawgrass) is most abundant; other common herbs include *Carex lacustris* (hairy sedge), *Rhynchospora alba* (white beaksedge), and *Utricularia intermedia* (flatleaf bladderwort). *Myrica gale* (sweetgale) is the most abundant shrub. *Sphagnum* (sphagnum) spp. form an incomplete cover.

ENVIRONMENTAL DESCRIPTION

Global Environment: This community is typically found on marly coastal sites in northern Lake Michigan, Lake Huron, and Lake Superior in the United States. These sites occupy embayments of open, sandy shorelines where limestone bedrock or cobble is at or near the surface. These sites have calcareous soils (with a pH as high as 8.2), resulting either from calcareous substrates, water flow off adjacent limestone bedrock or limestone-rich till, or algal precipitation of calcium carbonate in the relatively warm, carbonate saturated waters (Minc and Albert 1998). On Isle Royale, a stand occurs in saturated peat on a wet depression of a lakeplain at Hidden Lake (C. Reschke pers. comm. 1999).

VEGETATION DESCRIPTION

Global Vegetation: These 'marly flats' contain a rich assemblage of calciphilic plants. Herbaceous species dominate parts of these areas. The dominant graminoid is *Calamagrostis canadensis* (bluejoint), but *Carex viridula* (little green sedge) and *Lobelia kalmii* (Ontario lobelia) are key diagnostics of this type. Other diagnostic species include *Cladium mariscoides* (smooth sawgrass), *Hypericum kalmianum* (Kalm's St. Johnswort), *Dichanthelium acuminatum* var. *lindheimeri* (Lindheimer panicgrass), *Argentina anserina* (silverweed cinquefoil), and *Triglochin maritima* (seaside arrowgrass). Scattered shrubs, such as *Dasiphora fruticosa* ssp. *floribunda* (shrubby-cinquefoil) or *Myrica gale* (sweetgale), may be present, but shrub cover is less than 25% (Minc and Albert 1998). In Wisconsin, in coastal estuaries of Lake Superior, common associates include *Cladium mariscoides* (smooth sawgrass), *Carex livida* (livid sedge), and *Triglochin maritima* (seaside arrowgrass). *Carex exilis* (coastal sedge) is codominant at several sites (E. Epstein pers. comm. 1999). On Isle Royale, a stand occurs in saturated peat on a wet depression of a lakeplain at Hidden Lake. Sedges dominate the vegetation. *Cladium mariscoides* (smooth sawgrass) is most abundant; other common herbs include *Carex lacustris* (hairy sedge), *Rhynchospora alba* (white beaksedge), and *Utricularia intermedia* (flatleaf bladderwort). *Myrica gale* (sweetgale) is the most abundant shrub. *Sphagnum* (sphagnum) spp. form an incomplete cover (C. Reschke pers. comm. 1999).

CONSERVATION STATUS RANK

Global Rank & Reasons: G1G2 (12-Apr-2000). Eleven sites totaling 1100 ha were identified by Minc and Albert (1998) as part of their Northern Rich Fen Complex, but it is not known if all sites contained this type and what its specific area is. Ten of the sites were ranked A or B quality. Ten of the eleven sites are in Michigan and one is in Wisconsin.

CLASSIFICATION

Classification Confidence: 3 - Weak
Global Comments: This type typically occurs as part of a Great Lakes Coastal Wetlands Complex (CECX005702). It is wetter and more herbaceous than the shrub-rich shore fen, *Dasiphora fruticosa* ssp. *floribunda - Myrica gale* Rich Shore Fen Shrubland

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(CEGL005275). Perhaps the shrub and graminoid type can be combined, depending on their spatial extent. Type concept was originally taken from the southern Ontario list of vegetation types by Lee et al. (1998), but it may, in fact, have been deleted by them and combined into their Graminoid Coastal Meadow Marsh type, which is tracked globally as the interdunal wetland type, *Dasiphora fruticosa* ssp. *floribunda / Cladium mariscoides - Juncus balticus - (Rhynchospora capillacea)* Herbaceous Vegetation (CEGL005105). That type is a more southern Great Lakes region type that may occur either on the Great Lakes shoreline or on inland lakes. This type may be very similar to an inland extremely rich graminoid fen, *Carex lasiocarpa - Trichophorum caespitosum - Rhynchospora capillacea / Andromeda polifolia* Herbaceous Vegetation (CEGL002496).

Global Similar Associations:

- *Carex lasiocarpa - (Carex rostrata) - Equisetum fluviatile* Herbaceous Vegetation (CEGL005229)--also a graminoid shore fen, but not as rich.
- *Carex lasiocarpa - Trichophorum caespitosum - Rhynchospora capillacea / Andromeda polifolia* Herbaceous Vegetation (CEGL002496)--an inland extremely rich seepage fen.
- *Cladium mariscoides - (Carex lasiocarpa, Hypericum kalmianum, Oligoneuron riddellii, Eleocharis elliptica)* Herbaceous Vegetation (CEGL005104)--twigrush wet prairie type.
- *Dasiphora fruticosa* ssp. *floribunda - Myrica gale* Rich Shore Fen Shrubland (CEGL005275)--shrubby version of the same type.
- *Dasiphora fruticosa* ssp. *floribunda / Cladium mariscoides - Juncus balticus - (Rhynchospora capillacea)* Herbaceous Vegetation (CEGL005105)--more southern Great Lakes type, interdunal wetland.
- Limestone Cobble - Gravel Great Lakes Shore Sparse Vegetation (CEGL005169)

Global Related Concepts:

- Northern Rich Fen (Chapman et al. 1989) B

ELEMENT DISTRIBUTION

Global Range: This community is typically found on marly coastal sites in northern Lake Michigan, Lake Huron, and Lake Superior in the United States, in both northern Michigan and northern Wisconsin, and possibly in Ontario, Canada.
Nations: CA?, US
States/Provinces: MI, ON?, WI
USFS Ecoregions (1994/95): 212H:CC, 212:Oa:CCC
Federal Lands: NPS (Isle Royale, Sleeping Bear Dunes)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: This association was not sampled with plots at Sleeping Bear Dunes NL.
Sleeping Bear Dunes National Lakeshore Map Code: HSM
Local Description Authors: NA
Global Description Authors: D. Faber-Langendoen
References: Chapman et al. 1989, Greenall 1996, Midwestern Ecology Working Group n.d., Minc and Albert 1998, Reschke pers. comm., WNHIP unpubl. data

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Woolly-fruit Sedge Shore Fen

***Carex lasiocarpa* - *(Carex rostrata)* - *Equisetum fluviatile* Herbaceous Vegetation**
Woolly-fruit Sedge - (Beaked Sedge) - Water Horsetail Herbaceous Vegetation
Identifier: CEGL005229

NVC CLASSIFICATION

Division	North American Bog & Fen (2.C.4.Na)
Macrogroup	North American Boreal Bog & Fen (M062)
Group	Eastern North American Boreal Alkaline Fen Group (G185)
Association (Common name)	Woolly-fruit Sedge Shore Fen
Ecological System(s):	Laurentian-Acadian Alkaline Fen (CES201.585)

ELEMENT CONCEPT

Global Summary: This community is found typically on floating (or occasionally grounded) mats on the edges of lakes and streams in the Great Lakes region of the United States and Canada. Lakes and streams have low wave and current energy and seasonally flood the mat. Permanent surface pools and small hummocks with *Sphagnum* (sphagnum) spp. and ericaceous shrubs may be present. The substrate is a mat of fibric to mesic peat held together by roots and rhizomes. Graminoids dominate the stand, with shrub cover typically much less than 25%. *Myrica gale* (sweetgale) can be among the more common shrubs. The graminoid *Carex lasiocarpa* (woollyfruit sedge) can form extensive "lawns." Other herbaceous species present include *Carex rostrata* (beaked sedge), *Eleocharis elliptica* (elliptic spikerush), *Equisetum fluviatile* (water horsetail), *Comarum palustre* (purple marshlocks), *Rhynchospora alba* (white beaksedge), *Triadenum fraseri* (Fraser's marsh St. Johnswort), *Utricularia intermedia* (flatleaf bladderwort), and *Utricularia minor* (lesser bladderwort). *Menyanthes trifoliata* (buckbean) can occur at high cover, especially at the outer edge of the floating mat.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This wetland sedge - peatmoss community was sampled twice in the park at Round Lake. The sites are flat, saturated lakeplains with very poorly drained peat soil. The unvegetated surface is dominated by leaf litter (90-95% cover) with some bare soil (0-5%) and dead plant stems (5%). Evidence of disturbance includes some deer browse.
Global Environment: This community is found typically on floating (or occasionally grounded) mats on the edges of lakes and streams. Lakes and streams have low wave and current energy and seasonally flood the mat. Permanent surface pools and small hummocks with *Sphagnum* (sphagnum) spp. and ericaceous shrubs may be present. The substrate is a mat of fibric to mesic peat held together by roots and rhizomes.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The dense (80% cover) herbaceous layer is dominated by *Carex lasiocarpa* (woollyfruit sedge); *Cladium mariscoides* (smooth sawgrass) may codominate. Additional species may include graminoids *Agrostis hyemalis* (winter bentgrass), *Eleocharis elliptica* (elliptic spikerush), *Rhynchospora alba* (white beaksedge), and *Schoenoplectus acutus* (hardstem bulrush); forbs *Campanula aparinoides* (marsh bellflower), *Cicuta bulbifera* (bulblet-bearing water hemlock), *Epilobium leptophyllum* (bog willowherb), *Eupatorium maculatum* (spotted joepyeweed), *Eupatorium perfoliatum* (common boneset), *Liparis loeselii* (yellow widelip orchid), *Lobelia kalmii* (Ontario lobelia), *Lycopus uniflorus* (northern bugleweed), *Scutellaria lateriflora* (blue skullcap), *Solidago patula* (roundleaf goldenrod), *Solidago uliginosa* (bog goldenrod), and *Triadenum fraseri* (Fraser's marsh St. Johnswort); and fern *Thelypteris palustris* (eastern marsh fern). Sphagnum mosses cover 90% of the ground surface.
Global Vegetation: Graminoids dominate the stand, with shrub cover typically much less than 25%. *Myrica gale* (sweetgale) can be among the more common shrubs. The graminoid *Carex lasiocarpa* (woollyfruit sedge) can form extensive 'lawns.' Other herbaceous species present include *Carex rostrata* (beaked sedge), *Eleocharis elliptica* (elliptic spikerush), *Equisetum fluviatile* (water horsetail), *Comarum palustre* (purple marshlocks), *Rhynchospora alba* (white beaksedge), *Triadenum fraseri* (Fraser's marsh St. Johnswort), *Utricularia intermedia* (flatleaf bladderwort), and *Utricularia minor* (lesser bladderwort). *Menyanthes trifoliata* (buckbean) can occur at high cover, especially at the outer edge of the floating mat (Harris et al. 1996).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Carex lasiocarpa* (woollyfruit sedge), *Cladium mariscoides* (smooth sawgrass)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Carex lasiocarpa* (woollyfruit sedge), *Cladium mariscoides* (smooth sawgrass), *Lycopus uniflorus* (northern bugleweed), *Schoenoplectus acutus* var. *acutus* (hardstem bulrush), *Thelypteris palustris* (eastern marsh fern)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (1-Dec-1997).

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CLASSIFICATION

Classification Confidence: 2 - Moderate

Global Comments: This type is wetter than low shrub shore fen, *Chamaedaphne calyculata - Myrica gale / Carex lasiocarpa* Dwarf-shrubland (CEGL005228), and has structural similarities to bluejoint meadows, but the mat tends to float and the surface is less frequently flooded (Harris et al. 1996). Shore fens may also resemble Narrow-leaf Sedge Organic meadow marshes in Ontario and the concept of shore fen has not been standardized across the province yet (W. Bakowsky pers. comm. 1999). In the Great Lakes shore fens, a more nutrient-rich type has been described separately, *Calamagrostis canadensis - Carex viridula - Cladium mariscoides - Lobelia kalmii* Herbaceous Vegetation (CEGL005115).

Global Similar Associations:

- *Calamagrostis canadensis - Carex viridula - Cladium mariscoides - Lobelia kalmii* Herbaceous Vegetation (CEGL005115)--is a rich graminoid shore fen in the Great Lakes, and may not typically have *Carex lasiocarpa*.
- *Carex lasiocarpa - Calamagrostis* spp. - (*Eleocharis rostellata*) Herbaceous Vegetation (CEGL002383)
- *Carex lasiocarpa* Herbaceous Vegetation (CEGL001810)
- *Chamaedaphne calyculata - Myrica gale / Carex lasiocarpa* Dwarf-shrubland (CEGL005228)
- *Dasiphora fruticosa* ssp. *floribunda - Myrica gale* Rich Shore Fen Shrubland (CEGL005275)--is a rich shrub shore fen in the Great Lakes region.

Global Related Concepts:

- Northern Rich Fen (Chapman et al. 1989) ?
- Open graminoid shore fen: wire sedge (W14) (Harris et al. 1996) =

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled at Round Lake.

Global Range: This community is found typically on floating (or occasionally grounded) mats on the edges of lakes and streams in the Great Lakes region of the United States and Canada. It ranges from northern Minnesota and adjacent Ontario eastward to localized areas of Michigan and New York. In New York, one site (Deer Creek) is known along the shores of eastern Lake Ontario.

Nations: CA, US

States/Provinces: MI, MN, NY, ON, QC, VT, WI:S3

USFS Ecoregions (1994/95): 212Hi:CCC, 212Ho:CCC, 212Hw:CCC, 212La:CCC, 212:Oa:CCC, 222Ie:CCC

Federal Lands: NPS (Apostle Islands, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs)

Federal Lands: Information not available.

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.56, SLBE.57.

Sleeping Bear Dunes National Lakeshore Map Code: HSS

Local Description Authors: M.J. Russo

Global Description Authors: D. Faber-Langendoen

References: Chapman et al. 1989, Edinger et al. 2002, Harris et al. 1996, Midwestern Ecology Working Group n.d., WNHIP unpubl. data

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Leatherleaf - Sweetgale Shore Fen

***Chamaedaphne calyculata - Myrica gale / Carex lasiocarpa* Dwarf-shrubland**
Leatherleaf - Sweetgale / Woolly-fruit Sedge Dwarf-shrubland
Identifier: CEGL005228

NVC CLASSIFICATION

Division	North American Bog & Fen (2.C.4.Na)
Macrogroup	North American Boreal Bog & Fen (M062)
Group	Eastern North American Boreal Alkaline Fen Group (G185)
Association (Common name)	Leatherleaf - Sweetgale Shore Fen
Ecological System(s):	Great Lakes Wooded Dune and Swale (CES201.726)
	Laurentian-Acadian Alkaline Fen (CES201.585)

ELEMENT CONCEPT

Global Summary: This leatherleaf - sweetgale dwarf-shrubland is typically found on floating mats on the edges of lakes and streams in the Great Lakes region of the United States and Canada. Stands occur where there is low wave and current energy with seasonal flooding. Hummocks with *Sphagnum* (sphagnum) spp. and ericaceous shrubs are often present but small in area. Shallow surface pools of water may persist throughout the growing season. Low shrubs dominate the stands, generally with over 60%. Dominant species include *Chamaedaphne calyculata* (leatherleaf) and *Myrica gale* (sweetgale). *Salix pedicellaris* (bog willow) is often present. The herbaceous layer is variable in cover and composition, sometimes shaded out by the heavy shrub cover. Species include *Calamagrostis canadensis* (bluejoint), *Carex aquatilis* (water sedge), *Carex lasiocarpa* (woollyfruit sedge), *Carex rostrata* (beaked sedge), and *Comarum palustre* (purple marshlocks). Diagnostic features of the type are high cover of *Chamaedaphne calyculata* (leatherleaf) with one or more of the following minerotrophic species present: *Myrica gale* (sweetgale), *Betula pumila* (bog birch), *Salix* (willow) spp., *Carex lacustris* (hairy sedge), *Carex lasiocarpa* (woollyfruit sedge), *Typha latifolia* (broadleaf cattail), *Calamagrostis canadensis* (bluejoint), and *Iris versicolor* (harlequin blueflag).

ENVIRONMENTAL DESCRIPTION

Global Environment: This community is typically found on floating mats on the edges of lakes and streams. Stands occur where there is low wave and current energy, and where seasonal flooding may be expected (Harris et al. 1996). Seasonal flooding apparently tends to produce somewhat intermediate nutrient conditions, but depending on degree of flooding and water chemistry, individual stands may vary from moderately poor to moderately rich.

VEGETATION DESCRIPTION

Global Vegetation: Hummocks with *Sphagnum* (sphagnum) spp. and ericaceous shrubs are often present, but small in area. Shallow surface pools of water may persist throughout the growing season. Low shrubs dominate the stands, generally over 60%. Dominant species include *Chamaedaphne calyculata* (leatherleaf) and *Myrica gale* (sweetgale). *Salix pedicellaris* (bog willow) is often present. The herbaceous layer is variable in cover and composition, sometimes shaded out by the heavy shrub cover. Species include *Calamagrostis canadensis* (bluejoint), *Carex aquatilis* (water sedge), *Carex lasiocarpa* (woollyfruit sedge), *Carex rostrata* (beaked sedge), and *Comarum palustre* (purple marshlocks). Diagnostic features of the type are high cover of *Chamaedaphne calyculata* (leatherleaf) with one or more of the following minerotrophic species present: *Myrica gale* (sweetgale), *Betula pumila* (bog birch), *Salix* (willow) spp., *Carex lacustris* (hairy sedge), *Carex lasiocarpa* (woollyfruit sedge), *Typha latifolia* (broadleaf cattail), *Calamagrostis canadensis* (bluejoint), and *Iris versicolor* (harlequin blueflag) (Harris et al. 1996).

OTHER NOTEWORTHY SPECIES

Global: Vulnerable: *Iris lacustris* (dwarf lake iris, Federally listed threatened, G3)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (24-Mar-2000). Type is expected to be fairly common in Canada.

CLASSIFICATION

Classification Confidence: 2 - Moderate
Global Comments: Diagnostic features of the type are high cover of *Chamaedaphne calyculata* (leatherleaf) with one or more of the following minerotrophic species present: *Myrica gale* (sweetgale), *Betula pumila* var. *glandulifera* (bog birch), *Salix* (willow) spp., *Carex lacustris* (hairy sedge), *Carex lasiocarpa* (woollyfruit sedge), *Typha latifolia* (broadleaf cattail), *Calamagrostis canadensis* (bluejoint), and *Iris versicolor* (harlequin blueflag). Depending on the site, nutrient conditions may vary; however, rich shore fens along the Great Lakes are treated as a separate type, *Dasiphora fruticosa* ssp. *floribunda - Myrica gale* Rich Shore Fen Shrubland (CEGL005275). This type differs from the Leatherleaf Bog, *Chamaedaphne calyculata - Ledum groenlandicum - Kalmia polifolia* Bog Dwarf-shrubland (CEGL005278), and the Leatherleaf Poor Fen, *Chamaedaphne calyculata / Carex oligosperma / Sphagnum* spp. Poor Fen Dwarf-shrubland (CEGL005277) in that it harbors more minerotrophic indicator species which the Leatherleaf types lack, and tends to have less acidic indicators, such as *Carex oligosperma* (fewseed sedge). When cover of *Betula pumila* var. *glandulifera* (bog birch) and *Salix* (willow) spp. increases, this community can grade into a Bog Birch - Willow Shore Fen, *Alnus incana - Salix* spp. - *Betula pumila / Chamaedaphne calyculata* Shrubland (CEGL005227), or a Dogwood - Pussy Willow swamp, *Cornus sericea - Salix* spp. - (*Rosa palustris* (swamp rose)) Shrubland (CEGL002186). Greater than 25% cover of short (not dwarf) shrubs would warrant placing the stand into one of these other communities. This type is drier than graminoid shore fen, *Carex lasiocarpa - (Carex*

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rostrata) - *Equisetum fluviatile* Herbaceous Vegetation (CEGL005229), and is transitional to saturated rich and poor fens. Shore fens may also resemble organic shrub swamps in Ontario and the concept of shore fen has not been standardized across the province yet (W. Bakowsky pers. comm. 1999).

Global Similar Associations:

- *Alnus incana* - *Salix* spp. - *Betula pumila / Chamaedaphne calyculata* Shrubland (CEGL005227)
- *Carex lasiocarpa* - *(Carex rostrata)* - *Equisetum fluviatile* Herbaceous Vegetation (CEGL005229)
- *Chamaedaphne calyculata* - *Ledum groenlandicum* - *Kalmia polifolia* Bog Dwarf-shrubland (CEGL005278)
- *Chamaedaphne calyculata / Carex oligosperma / Sphagnum* spp. Poor Fen Dwarf-shrubland (CEGL005277)
- *Cornus sericea* - *Salix* spp. - (*Rosa palustris*) Shrubland (CEGL002186)
- *Dasiphora fruticosa* ssp. *floribunda* - *Myrica gale* Rich Shore Fen Shrubland (CEGL005275)--is a rich shore fen along the Great Lakes shoreline.
- *Myrica gale* - *Spiraea alba* - *Chamaedaphne calyculata* Shrubland (CEGL006512)
- *Myrica gale* Fen Shrubland (CEGL005141)
- *Myrica gale* Organic Swamp Shrubland (CEGL005077)

Global Related Concepts:

- Low shrub shore fen: leatherleaf - sweet gale / graminoid (W15) (Harris et al. 1996) =
- Northern Rich Fen (Chapman et al. 1989) ?

ELEMENT DISTRIBUTION

Global Range: This community is typically found on floating mats on the edges of lakes and streams in the Great Lakes region of the United States and Canada. It ranges from northern Minnesota and adjacent Ontario eastward to localized areas of Michigan and New York. In New York, one site (Deer Creek) is known along the shores of eastern Lake Ontario.

Nations: CA, US

States/Provinces: MI, MN, NY, ON, QC:S4?, VT, WI:S3

USFS Ecoregions (1994/95): 212Hi:CCC, 212Ia:CCC, 212Ja:CCC, 212La:CCC, 212:Oa:CCC, 222Ie:CCC

Federal Lands: NPS (Apostle Islands, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: This association was not sampled with plots at Sleeping Bear Dunes NL.

Sleeping Bear Dunes National Lakeshore Map Code: DLF

Local Description Authors: NA

Global Description Authors: D. Faber-Langendoen

References: Chapman et al. 1989, Edinger et al. 2002, Harris et al. 1996, Midwestern Ecology Working Group n.d., WNHIP unpubl. data

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Shrubby-cinquefoil - Sweetgale Rich Shore Fen

***Dasiphora fruticosa* ssp. *floribunda* - *Myrica gale* Rich Shore Fen Shrubland**
Shrubby-cinquefoil - Sweetgale Rich Shore Fen Shrubland
Identifier: CEGL005275

NVC CLASSIFICATION

Division	North American Bog & Fen (2.C.4.Na)
Macrogroup	North American Boreal Bog & Fen (M062)
Group	Eastern North American Boreal Alkaline Fen Group (G185)
Association (Common name)	Shrubby-cinquefoil - Sweetgale Rich Shore Fen
Ecological System(s):	Great Lakes Alkaline Rocky Shore and Cliff (CES201.995)
	Northern Great Lakes Coastal Marsh (CES201.722)

ELEMENT CONCEPT

Global Summary: This community is typically found on marly coastal sites in northern Lake Michigan and Lake Huron in the United States and possibly Canada. These sites occupy embayments of open, sandy shorelines where limestone bedrock or cobble is at or near the surface. These sites have calcareous soils (with a pH as high as 8.2), resulting either from calcareous substrates, waterflow off adjacent limestone bedrock or limestone-rich till, or algal precipitation of calcium carbonate in the relatively warm, carbonate-saturated waters. These 'marly flats' contain a rich assemblage of calciphilic plants. Short shrubs dominate parts of these areas. Typical dominants include *Myrica gale* (sweetgale) and *Dasiphora fruticosa* ssp. *floribunda* (shrubby-cinquefoil), generally over 60% (?). *Larix laricina* (tamarack) and *Salix pedicellaris* (bog willow) are often present. The herbaceous layer is variable in cover and composition, sometimes shaded out by the heavy shrub cover. Species include *Calamagrostis canadensis* (bluejoint), *Carex viridula* (little green sedge), *Carex lasiocarpa* (woollyfruit sedge), and *Cladium mariscoides* (smooth sawgrass).

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This shrubby-cinquefoil - sweetgale shrubland was sampled once in the park. The site is a flat saturated swale within Shalda Creek with very poorly drained peat soil. The unvegetated surface is dominated by leaf litter (85% cover) with some bare soil (5%) and dead plant stems (10%). No evidence of disturbance was reported.
Global Environment: These sites occupy embayments of open, sandy shorelines where limestone bedrock or cobble is at or near the surface. These sites have calcareous soils (with a pH as high as 8.2), resulting either from calcareous substrates, water flow off adjacent limestone bedrock or limestone-rich till, or algal precipitation of calcium carbonate in the relatively warm, carbonate saturated waters (Minc and Albert 1998).

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: This floristically simple shrubland is dominated by a dense (90% cover) short-shrub layer (0.5-1 m) of *Dasiphora fruticosa* ssp. *floribunda* (shrubby-cinquefoil) and *Myrica gale* (sweetgale); additional shrubs include *Cornus sericea* (red-osier dogwood) and *Rosa palustris* (swamp rose). The sparse (20%) herbaceous layer is comprised of *Carex stricta* (upright sedge), *Thelypteris palustris* (eastern marsh fern), *Triadenum fraseri* (Fraser's marsh St. Johnswort), and *Typha latifolia* (broadleaf cattail).
Global Vegetation: These 'marly flats' contain a rich assemblage of calciphilic plants. Short shrubs dominate parts of these areas. Typical dominants include *Myrica gale* (sweetgale) and *Dasiphora fruticosa* ssp. *floribunda* (shrubby-cinquefoil), generally over 60% (?). *Larix laricina* (tamarack) and *Salix pedicellaris* (bog willow) are often present. The herbaceous layer is variable in cover and composition, sometimes shaded out by the heavy shrub cover. Species include *Calamagrostis canadensis* (bluejoint), *Carex viridula* (little green sedge), *Carex lasiocarpa* (woollyfruit sedge), and *Cladium mariscoides* (smooth sawgrass) (Minc and Albert 1998).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved evergreen shrub	*Dasiphora fruticosa* ssp. *floribunda* (shrubby-cinquefoil), *Myrica gale* (sweetgale)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Dasiphora fruticosa* ssp. *floribunda* (shrubby-cinquefoil), *Myrica gale* (sweetgale), *Rosa palustris* (swamp rose)

CONSERVATION STATUS RANK

Global Rank & Reasons: G1G2 (12-Apr-2000). Eleven sites were identified by Minc and Albert (1998) as part of their Northern Rich Fen Complex, totaling 1100 ha, but it is not known if all sites contained this type and what its specific area is. Ten of the sites were ranked A or B quality. Ten of the eleven sites are in Michigan and one is in Wisconsin.

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CLASSIFICATION

Classification Confidence: 3 - Weak
Global Comments: This type typically occurs as part of a Great Lakes Coastal Wetlands Complex (CECX005702). It is drier and more shrubby than the graminoid rich shore fen, *Calamagrostis canadensis - Carex viridula - Cladium mariscoides - Lobelia kalmii* Herbaceous Vegetation (CEGL005115). Perhaps the shrub and graminoid type can be combined, depending on their spatial extent.
Global Similar Associations:
- *Alnus incana - Salix* spp. - *Betula pumila / Chamaedaphne calyculata* Shrubland (CEGL005227)
- *Betula pumila - Dasiphora fruticosa* ssp. *floribunda / Carex lasiocarpa - Trichophorum alpinum* Shrubland (CEGL002495)
- *Calamagrostis canadensis - Carex viridula - Cladium mariscoides - Lobelia kalmii* Herbaceous Vegetation (CEGL005115)
- *Carex lasiocarpa - (Carex rostrata) - Equisetum fluviatile* Herbaceous Vegetation (CEGL005229)
- *Chamaedaphne calyculata - Myrica gale / Carex lasiocarpa* Dwarf-shrubland (CEGL005228)
- *Thuja occidentalis - (Myrica gale) / Trichophorum alpinum / Drepanocladus* spp. Shrubland (CEGL005193)

Global Related Concepts:
- Northern Rich Fen (Chapman et al. 1989) B

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Shalda Creek.
Global Range: This community is typically found on marly coastal sites in northern Lake Michigan and Lake Huron in the United States, in both northern Michigan and northern Wisconsin, and possibly in Ontario, Canada.
Nations: CA?, US
States/Provinces: MI, ON?, WI
USFS Ecoregions (1994/95): 212Ho:CCC, 212Hw:CCC, 212:Oa:CCC
Federal Lands: NPS (Sleeping Bear Dunes)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.76.
Sleeping Bear Dunes National Lakeshore Map Code: SSF
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Chapman et al. 1989, Midwestern Ecology Working Group n.d., Minc and Albert 1998, WNHIP unpubl. data

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2.C.5. Temperate & Boreal Freshwater Wet Meadow & Marsh

2.C.5.Na. Eastern North America Freshwater Wet Meadow, Riparian & Marsh

M067. Atlantic & Gulf Coastal Plain Pondshore & Wet Meadow

G111. Atlantic & Gulf Coastal Plain Pondshore & Wet Prairie Group

Inland Coastal Plain Marsh

***Rhynchospora capitellata - Rhexia virginica - Rhynchospora scirpoides - Schoenoplectus hallii* Herbaceous Vegetation**

Brownish Beaksedge - Virginia Meadowbeauty - Longbeak Beaksedge - Hall's Bulrush Herbaceous Vegetation

Identifier: CEGL005108

NVC CLASSIFICATION

Division	Eastern North America Freshwater Wet Meadow, Riparian & Marsh (2.C.5.Na)
Macrogroup	Atlantic & Gulf Coastal Plain Pondshore & Wet Meadow (M067)
Group	Atlantic & Gulf Coastal Plain Pondshore & Wet Prairie Group (G111)
Association (Common name)	Inland Coastal Plain Marsh
Ecological System(s):	Northern Atlantic Coastal Plain Pond (CES203.518)

ELEMENT CONCEPT

Global Summary: This inland Coastal Plain marsh community is found in the Great Lakes region. Stands occur on sandy pitted outwash plains and glacial lakeplains. The level topography of these plains produces gently sloping, shallow basins with no outlets and sometimes no inlets. The water table fluctuates seasonally and yearly. It is highest in late winter and spring, and during years of high precipitation. The soils in this community are derived mainly from nutrient-poor to circumneutral, acidic (pH 4.4-7.0) sands. These conditions inhibit microbial decomposition and considerable organic material accumulates as peat. The peat mixes with sand or forms more-or-less pure deposits. The vegetation is dominated by herbaceous, mostly graminoid, species. Many of these species are annual or otherwise short-lived plants. They persist for years in the seedbank until the hydrologic conditions are right for germination. Many of these seedbank plants are species significantly disjunct from their main range on the Atlantic Coastal Plain. This plant community typically forms a distinct zonation in concentric bands: open water (when present); shallow water to recently emerged shore dominated by annual plant species and emergents; moist meadow typically dominated by *Calamagrostis canadensis* (bluejoint) and sometimes *Cladium mariscoides* (smooth sawgrass), *Rhynchospora capitellata* (brownish beaksedge), *Carex scoparia* (broom sedge), etc.; and shrub tree margin (when present), often with *Acer rubrum* (red maple), *Nyssa sylvatica* (blackgum), *Quercus palustris* (pin oak), *Photinia melanocarpa* (black chokeberry), *Vaccinium corymbosum* (highbush blueberry), *Cornus* (dogwood) spp., *Cephalanthus occidentalis* (common buttonbush). Common indicator species, such as *Symphyotrichum dumosum* (rice button aster), *Eleocharis melanocarpa* (blackfruit spikerush), *Fuirena squarrosa* (hairy umbrella-sedge), *Lycopodiella appressa* (southern bog clubmoss), *Dichanthelium spretum* (Eaton's rosette grass), *Polygala cruciata* (drumheads), *Rhynchospora scirpoides* (longbeak beaksedge), *Rhynchospora macrostachya* (tall horned beaksedge), *Rotala ramosior* (lowland rotala), *Euthamia caroliniana* (slender goldentop), *Scleria reticularis* (netted nutrush), *Stachys hyssopifolia* (hyssopleaf hedgenettle), and *Triadenum virginicum* (Virginia marsh St. Johnswort), are found on the northern Atlantic Coastal Plain, either disjunct or ranging west into the Lower Great Lakes region. About 48 species, including 11 indicators, are common components of this community; species include *Eriocaulon aquaticum* (sevenangle pipewort), *Fimbristylis autumnalis* (slender fimbry), *Lipocarpha micrantha* (smallflower halfchaff sedge), *Dichanthelium meridionale* (matting rosette grass), *Rhexia virginica* (handsome Harry), *Schoenoplectus smithii* (Smith's bulrush), *Viola lanceolata* (bog white violet), and *Xyris difformis* (bog yelloweyed grass).

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This beaksedge - bulrush wet meadow community was sampled once in the park. The site is a flat, saturated lakeplain with very poorly drained soil that was formed by a former beaver dam centuries ago. The unvegetated surface is made up of leaf litter (40% cover), bare soil (20%), dead plant stems (10%) and mosses (30%). Evidence of disturbance includes dead standing trees resulting from more recent beaver activity (20-30 years ago).

Global Environment: This community occurs on sandy pitted outwash plains and sandy glacial lakeplains, where it is found on shores of softwater seepage lakes, ponds, or depressions. The level topography of these plains produces gently sloping, shallow basins with no outlets and sometimes no inlets. The water table fluctuates seasonally and yearly. It is highest in late winter and spring, and during years of high precipitation. Four zones of flooding regimes may be recognized, Zone 1 is open water (when present), Zone 2 is intermittently exposed (usually inundated), Zone 3 is either seasonally flooded (inundated for part of the growing season) or saturated due to season, and Zone 4 is temporarily flooded (rarely inundated except during periods of high precipitation). Complete drawdown is possible during drought, exposing the bottoms of the basins.

The soils in this community are derived mainly from sand. The sand is poor in nutrients and is acidic to circumneutral, with pH ranging from 4.4-7.0. Lake water that is circumneutral tends to raise the pH of soils nearest the lake. The acidic, nutrient-poor conditions inhibit microbial decomposition and considerable organic material accumulates as peat. The peat mixes with sand or forms more-or-less pure deposits. Basin shorelines typically have stretches of pure sand in areas where wave action is greatest, pure peat in

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protected areas, and a mixture of the two substrates in other areas. In some basins, an impermeable layer of clay develops 2-5 m below the surface. This layer may hold the local water table above the regional water table for long periods.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: This sparsely vegetated (40% cover) community is dominated by *Rhynchospora capillacea* (needle beaksedge) and *Schoenoplectus acutus* (hardstem bulrush). Additional herbaceous species include *Carex flava* (yellow sedge), *Cirsium muticum* (swamp thistle), *Cladium mariscoides* (smooth sawgrass), *Dichanthelium acuminatum* var. *fasciculatum* (western panicgrass), *Eupatorium maculatum* (spotted joepyeweed), *Eupatorium perfoliatum* (common boneset), *Lobelia kalmii* (Ontario lobelia), *Lycopus uniflorus* (northern bugleweed), *Packera paupercula* (balsam groundsel), *Solidago rugosa* (wrinkleleaf goldenrod), *Viola nephrophylla* (northern bog violet), and insectivorous *Drosera rotundifolia* (roundleaf sundew). In addition, there a few scattered (10%) *Thuja occidentalis* (northern white-cedar) (1-5 m tall).

Global Vegetation: Graminoids and forbs dominate the main part of this wetland community. This plant community typically forms a distinct zonation in concentric bands: open water (when present); shallow water to recently emerged shore dominated by annual plant species and emergents; moist meadow typically dominated by *Calamagrostis canadensis* (bluejoint) and sometimes *Cladium mariscoides* (smooth sawgrass), *Rhynchospora capitellata* (brownish beaksedge), *Carex scoparia* (broom sedge), etc.; and shrub tree margin (when present), often with *Acer rubrum* (red maple), *Nyssa sylvatica* (blackgum), *Quercus palustris* (pin oak), *Photinia melanocarpa* (black chokeberry), *Vaccinium corymbosum* (highbush blueberry), *Cornus* (dogwood) spp., and *Cephalanthus occidentalis* (common buttonbush). Common indicator species, such as *Symphyotrichum dumosum* (rice button aster), *Eleocharis melanocarpa* (blackfruit spikerush), *Fuirena squarrosa* (hairy umbrella-sedge), *Lycopodiella appressa* (southern bog clubmoss), *Dichanthelium spretum* (Eaton's rosette grass), *Polygala cruciata* (drumheads), *Rhynchospora scirpoides* (longbeak beaksedge), *Rhynchospora macrostachya* (tall horned beaksedge), *Rotala ramosior* (lowland rotala), *Euthamia caroliniana* (slender goldentop), *Scleria reticularis* (netted nutrush), *Stachys hyssopifolia* (hyssopleaf hedgenettle), and *Triadenum virginicum* (Virginia marsh St. Johnswort), found on the northern Atlantic Coastal Plain, either disjunct or ranging west into the Lower Great Lakes region. About 48 species, including 11 indicators, are common components of this community; species include *Eriocaulon aquaticum* (sevenangle pipewort), *Fimbristylis autumnalis* (slender fimbry), *Lipocarpha micrantha* (smallflower halfchaff sedge), *Dichanthelium meridionale* (matting rosette grass), *Rhexia virginica* (handsome Harry), *Schoenoplectus smithii* (Smith's bulrush), *Viola lanceolata* (bog white violet), and *Xyris difformis* (bog yelloweyed grass). Many of the characteristic species of this community are annuals. They are favored by and persist because of periodic drawdowns of pond or lake levels that expose bare substrate for germination.

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Rhynchospora capillacea* (needle beaksedge), *Schoenoplectus acutus* var. *acutus* (hardstem bulrush)

Global

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Calamagrostis canadensis* (bluejoint), *Carex scoparia* (broom sedge), *Cladium mariscoides* (smooth sawgrass), *Eleocharis melanocarpa* (blackfruit spikerush), *Fimbristylis autumnalis* (slender fimbry), *Rhynchospora macrostachya* (tall horned beaksedge), *Rhynchospora scirpoides* (longbeak beaksedge)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Rhynchospora capillacea* (needle beaksedge), *Schoenoplectus acutus* var. *acutus* (hardstem bulrush)

Global: *Dichanthelium spretum* (Eaton's rosette grass), *Eleocharis atropurpurea* (purple spikerush), *Eleocharis melanocarpa* (blackfruit spikerush), *Fuirena squarrosa* (hairy umbrella-sedge), *Rhynchospora macrostachya* (tall horned beaksedge), *Rhynchospora scirpoides* (longbeak beaksedge), *Schoenoplectus hallii* (Hall's bulrush), *Scleria reticularis* (netted nutrush)

OTHER NOTEWORTHY SPECIES

Global: Vulnerable: *Schoenoplectus hallii* (Hall's bulrush, vulnerable, G2G3); **Other**: *Brasenia schreberi* (watershield, occurs in Zone 1; indicates acidic, soft-water conditions., G5), *Eriocaulon aquaticum* (sevenangle pipewort, occurs in Zone 1; indicates acidic, soft-water conditions., G5)

CONSERVATION STATUS RANK

Global Rank & Reasons: G2? (22-Jun-1998). This type has a restricted natural distribution. A variety of urban and rural developments have affected the hydrology of these systems.

CLASSIFICATION

Classification Confidence: 2 - Moderate

Global Comments: Hydrology is typically seasonally flooded, but parts of stand may vary from temporarily flooded to saturated.

Global Similar Associations:

- *Rhexia virginica - Panicum verrucosum* Herbaceous Vegetation (CEGL006264)--is the more northern Atlantic Coastal Plain marsh.

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Global Related Concepts:

- Palustrine (Cowardin et al. 1979) B

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled in the Bow Lake Unit.

Global Range: This inland coastal plain marsh community is found in the Great Lakes region of the midwestern United States and Canada. Ninety percent of the occurrences of this community are within 160 km of the southeastern shore of Lake Michigan in southwestern Lower Michigan and northeastern Indiana. This community also is found in the central Wisconsin sandplain and the outwash of northwestern Wisconsin. There is a concentration of sites on the till plains of Georgian Bay, Ontario. Smaller concentrations occur on outwash and lakeplains in northern Lower Michigan and eastern Upper Michigan.

Nations: CA, US

States/Provinces: IN, MI:S2, ON:S3, WI:S1

USFS Ecoregions (1994/95): 212Ho:CCC, 212Hu:CCC, 212Hv:CCP, 212Hw:CCC, 212Hx:CCC, 212Ka:C?? , 212:Oa:CCC, 222Ge:CCC, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222Jj:CCC, 222Ka:CCC, 222Kb:CCC

Federal Lands: NPS (Sleeping Bear Dunes); USFS (Huron-Manistee, Huron?, Manistee)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.67.

Sleeping Bear Dunes National Lakeshore Map Code: HCP

Local Description Authors: M.J. Russo

Global Description Authors: J. Drake, D. Faber-Langendoen, and D. Ambrose

References: Brodowicz 1989, Chapman et al. 1989, Cowardin et al. 1979, Jackson and Singer 1997, Keddy and Sharp 1989, Midwestern Ecology Working Group n.d., Reznicek 1994, WNHIP unpubl. data

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M303. Eastern North American Ruderal Wet Meadow & Marsh

G556. Northern & Central Ruderal Wet Meadow & Marsh Group

Eastern Reed Marsh

***Phragmites australis* Eastern North America Temperate Semi-natural Herbaceous Vegetation**
Common Reed Eastern North America Temperate Semi-natural Herbaceous Vegetation
Identifier: CEGL004141

NVC CLASSIFICATION

Division	Eastern North America Freshwater Wet Meadow, Riparian & Marsh (2.C.5.Na)
Macrogroup	Eastern North American Ruderal Wet Meadow & Marsh (M303)
Group	Northern & Central Ruderal Wet Meadow & Marsh Group (G556)
Association (Common name)	Eastern Reed Marsh
Ecological System(s):	North-Central Interior Freshwater Marsh (CES202.899)
	Semi-natural / Altered Vegetation and Conifer Plantations (CES203.074)

ELEMENT CONCEPT

Global Summary: This reed marsh type is found across the east-temperate regions of the United States and Canada. Stands occur in semipermanently flooded marshes, ditches, impoundments, etc., that have often been disturbed by human activity. The vegetation is variable, as *Phragmites australis* (common reed) will often invade into existing natural or semi-natural communities present on the site. Once firmly established, this community is usually strongly dominated by *Phragmites australis* (common reed), with few or no other vascular plants present.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This reed marsh community was sampled once in the park at Round Lake. The site is a flat, saturated lakeplain with poorly drained peat soil. The unvegetated surface is dominated by leaf litter (80% cover) with some dead plant stems (20%). No evidence of disturbance was reported.
Global Environment: Stands occur in semipermanently flooded marshes, ditches, impoundments, etc. that have often been disturbed by human activity.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: This moderately vegetated (60% cover) herbaceous community is codominated by *Phragmites australis* (common reed) and *Thelypteris palustris* (eastern marsh fern). Additional herbs include graminoids *Agrostis hyemalis* (winter bentgrass), *Carex aquatilis* (water sedge), *Cladium mariscoides* (smooth sawgrass), and *Eleocharis elliptica* (elliptic spikerush); forbs *Epilobium leptophyllum* (bog willowherb), *Solidago patula* (roundleaf goldenrod), *Solidago rugosa* (wrinkleleaf goldenrod), *Triadenum fraseri* (Fraser's marsh St. Johnswort), and insectivorous *Drosera rotundifolia* (roundleaf sundew); and fern *Osmunda regalis* (royal fern). In addition, there is a very sparse (5%) tall-shrub layer (2-5 m tall) of *Thuja occidentalis* (northern white-cedar) and *Pinus strobus* (eastern white pine) and a moderate (40%) short-shrub layer (0.5-1 m) that includes *Acer rubrum* (red maple), *Cornus amomum* (silky dogwood), *Cornus sericea* (red-osier dogwood), *Rosa palustris* (swamp rose), and *Salix candida* (sageleaf willow). Nonvascular species (sphagnum mosses) cover 30% of the ground surface.
Global Vegetation: The vegetation is often variable, as *Phragmites australis* (common reed) will often invade into existing natural or semi-natural communities present on the site. Once firmly established, this community is usually strongly dominated by *Phragmites australis* (common reed), with few or no other vascular plants present.

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Phragmites australis* (common reed)
Herb (field)	Fern or fern ally	*Thelypteris palustris* (eastern marsh fern)

Global

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Phragmites australis* (common reed)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Osmunda regalis* (royal fern), *Phragmites australis* (common reed), *Thelypteris palustris* (eastern marsh fern)
Global: *Phragmites australis* (common reed)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (invasive) (23-Nov-1997). Although almost always occurring as a naturalized type that arises from human disturbance, some stands in northern Minnesota and further north in Canada may be native. If so, they should be tracked as a separate type.

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CLASSIFICATION

Classification Confidence: 1 - Strong

Global Comments: This is not a native community but is the result of the invasion of alien *Phragmites australis* (common reed) into natural or semi-natural vegetation. The vegetation has variable hydrology and, unless *Phragmites* (reed) is clearly dominant, is often treated as part of other marsh and meadow types. The geographic distribution of the type is arbitrarily limited to Bailey's Humid Temperate Domain in eastern North America (Bailey 1997, 1998). Stands in northern Minnesota and farther north in Canada may represent native stands. If so, they should be tracked as a different type. Tidal vegetation of the Gulf Coast of Louisiana and Texas dominated by *Phragmites australis* (common reed) is classified in the *Phragmites australis* (common reed) Tidal Herbaceous Alliance (A.1477).

Global Similar Associations:

- *Phragmites australis* Tidal Herbaceous Vegetation (CEGL004187)
- *Phragmites australis* Western North America Temperate Semi-natural Herbaceous Vegetation (CEGL001475)

Global Related Concepts:

- *Phragmites australis* community (Metzler and Barrett 1992) ?
- *Phragmites australis* tidal marsh association (Clancy 1993b) ?
- Inland Emergent Marsh (Chapman et al. 1989) B
- Southern New England nutrient-poor streamside/lakeside marsh (Rawinski 1984) ?
- Southern New England nutrient-rich streamside/lakeside marsh (Rawinski 1984) ?

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled at Round Lake.

Global Range: This reed marsh type is found across the east-temperate regions of the United States and Canada, ranging from Maine west to the eastern Dakotas and Manitoba, south to Texas and east to Florida.

Nations: CA, US

States/Provinces: AL, AR, CT, DE, FL, GA, IA, IN, LA, MA, MD, ME, MI, MN, MS, NC, NH, NJ:S5, NY, OH, ON, PA, QC:S3?, RI, SC, TX, VA, VT, WI, WV

USFS Ecoregions (1994/95): 212C:CP, 212Fc:CCC, 212Ho:CCC, 212Hw:CCC, 212:Oa:CCC, 221Aa:CCP, 221Ae:CCC, 221Ai:CCC, 221Bc:CCC, 221Da:CCC, 222Ic:CCC, 222Jj:CCC, 231Fb:CCC, 232Ab:CCC, 232Ac:CCC, 232C:CC, 232Dc:CCC, 232E:CC, 232G:CC, 234A:PP, 255Dc:CCC, M212:C, M221:P

Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Indiana Dunes, Minute Man, Saint Croix, Saratoga, Sleeping Bear Dunes, Upper Delaware, Voyageurs); USFWS (Alligator River, Aransas, Bon Secour, Brazoria, Cape May, E.B. Forsythe, Great Dismal Swamp, Great Meadows, Great Swamp, Matagorda Island, Montezuma, Nomans Land Island?, Oxbow, Parker River, Prime Hook, Supawna Meadows)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.59.

Sleeping Bear Dunes National Lakeshore Map Code: HPG

Local Description Authors: M.J. Russo

Global Description Authors: D. Faber-Langendoen

References: Bailey 1997, Bailey 1998, Bell et al. 2002, Chapman et al. 1989, Clancy 1993b, Harris et al. 1996, INAI unpubl. data, Metzler and Barrett 1992, Metzler and Barrett 2001, NRCS 2004a, Nelson 1986, Rawinski 1984, Schafale and Weakley 1990, Schotz pers. comm., Southeastern Ecology Working Group n.d., Swain and Kearsley 2001

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M069. Eastern North American Wet Meadow & Marsh

G125. Eastern North American Freshwater Marsh Group

Northern Great Lakes Emergent Marsh

Schoenoplectus acutus - Schoenoplectus subterminalis - Eleocharis palustris - (Schoenoplectus americanus)
Northern Great Lakes Shore Herbaceous Vegetation
Hardstem Bulrush - Water Bulrush - Common Spikerush - (Chairmaker's Bulrush) Northern Great Lakes Shore Herbaceous Vegetation
Identifier: CEGL005274

NVC CLASSIFICATION

Division	Eastern North America Freshwater Wet Meadow, Riparian & Marsh (2.C.5.Na)
Macrogroup	Eastern North American Wet Meadow & Marsh (M069)
Group	Eastern North American Freshwater Marsh Group (G125)
Association (Common name)	Northern Great Lakes Emergent Marsh
Ecological System(s):	Northern Great Lakes Coastal Marsh (CES201.722)

ELEMENT CONCEPT

Global Summary: This emergent marsh type is found along northern Great Lakes shorelines in Lake Huron, Lake Michigan, Lake Superior, and along the St. Mary's River in the United States and Canada. Stands occur in a variety of shoreline contexts, including clay lakeplains, sand lakeplains, and sandy ground moraines. They typically occur in open water and stream margins within estuarine sites, often within a much larger poor fen. Stands in Lake Huron and Lake Michigan are found in relatively protected coastal embayments. Stands along the St. Mary's River occur in channel-side wetlands and embayments. The emergent vegetation is open, sometimes sparse. Species typically include *Schoenoplectus acutus* (hardstem bulrush) and *Eleocharis palustris* (common spikerush), along with *Equisetum fluviatile* (water horsetail), *Najas flexilis* (nodding waternymph), *Schoenoplectus subterminalis* (swaying bulrush), and *Sparganium eurycarpum* (broadfruit bur-reed). *Schoenoplectus americanus* (chairmaker's bulrush) can be common in some sites, e.g., open stretches of some bays may contain a narrow, but dense fringe, apparently due to its greater tolerance of extreme wave action. Some sites may contain species more typical of southern Great Lakes marshes, such as *Najas flexilis* (nodding waternymph), *Schoenoplectus tabernaemontani* (softstem bulrush), and *Typha angustifolia* (narrowleaf cattail). Sites in calcium-rich areas may also contain *Eleocharis rostellata* (beaked spikerush) and *Chara* spp. Submergents within this zone include *Potamogeton gramineus* (variableleaf pondweed) and *Potamogeton natans* (floating pondweed).

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This bulrush marsh community was sampled at three locations in the park. Sites include an intermittently, gentle southwest-facing beach slope and a saturated depression and lakeshore. Soils are very poorly drained sand and poorly drained muck. The unvegetated surface is made up of leaf litter (0-70% cover), bare sand (0-80%), dead plant stems (0-30%) and standing water (0-50%). Evidence of disturbance includes dead standing trees, lower water levels due to drought, wave erosion, and the presence of exotic plants.

Global Environment: Stands occur in a variety of shoreline contexts, including clay lakeplains, sand lakeplains, and sandy ground moraines. They typically occur in open water and stream margins within estuarine sites, often within a much larger poor fen. Stands in Lake Huron and Lake Michigan are found in relatively protected coastal embayments. Stands along the St. Mary's River occur in channel-side wetlands and embayments. Substrate is mineral soil. Water depth generally exceeds 0.3 m (Minc 1996).

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: This very sparsely to very densely vegetated (5-90% cover) herbaceous community is dominated by *Schoenoplectus acutus* var. *acutus* (hardstem bulrush). Additional graminoids may include *Carex comosa* (longhair sedge), *Carex lasiocarpa* (woollyfruit sedge), *Carex viridula* (little green sedge), *Dulichium arundinaceum* (threeway sedge), *Juncus* (rush) sp., *Leersia oryzoides* (rice cutgrass), *Phalaris arundinacea* (reed canarygrass), *Phragmites australis* (common reed), *Schoenoplectus americanus* (chairmaker's bulrush), *Scirpus cyperinus* (woolgrass), and *Typha latifolia* (broadleaf cattail). Forbs may include *Bidens connata* (purplestem beggarticks), *Euthamia graminifolia* (flat-top goldentop), *Impatiens capensis* (jewelweed), *Lycopus uniflorus* (northern bugleweed), *Lysimachia thyrsiflora* (tufted loosestrife), *Mentha arvensis* (wild mint), *Polygonum amphibium* (water knotweed), *Symphyotrichum lateriflorum* (calico aster), and *Triadenum fraseri* (Fraser's marsh St. Johnswort). Aquatic plants include *Elodea canadensis* (Canadian waterweed), *Myriophyllum tenellum* (slender watermilfoil), *Najas flexilis* (nodding waternymph), *Nuphar lutea* ssp. *variegata*, *Potamogeton amplifolius* (largeleaf pondweed), and *Potamogeton gramineus* (variableleaf pondweed).

Global Vegetation: The emergent vegetation is open, sometimes sparse. Species typically include *Schoenoplectus acutus* (hardstem bulrush) and *Eleocharis palustris* (common spikerush), along with *Equisetum fluviatile* (water horsetail), *Najas flexilis* (nodding waternymph), *Schoenoplectus subterminalis* (swaying bulrush), and *Sparganium eurycarpum* (broadfruit bur-reed). *Schoenoplectus americanus* (chairmaker's bulrush) can be common in some sites, e.g., open stretches of some bays may contain a narrow, but dense fringe, apparently due to its greater tolerance of extreme wave action. Some sites may contain species more typical of southern Great Lakes marshes, such as *Najas flexilis* (nodding waternymph), *Schoenoplectus tabernaemontani* (softstem bulrush) and *Typha angustifolia* (narrowleaf cattail). Sites in calcium-rich areas may also contain *Eleocharis rostellata* (beaked spikerush) and *Chara* spp.

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Submergents within this zone include *Potamogeton gramineus* (variableleaf pondweed) and *Potamogeton natans* (floating pondweed) (Minc and Albert 1998).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Schoenoplectus acutus* var. *acutus* (hardstem bulrush)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Schoenoplectus acutus* var. *acutus* (hardstem bulrush)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Agrostis gigantea* (redtop, exotic, Medium/Low)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3? (12-Apr-2000). Twenty-nine sites were identified by Minc and Albert (1998) as part of their Northern Great Lakes Marsh type, but it is not known if all sites contained this type and what its specific area is. The type may also occur as small examples in the Lake Superior Poor Fen and Northern Rich Fen complexes. Twenty-four of the 29 sites were ranked A or B quality. One site is found in Minnesota, 22 are in Michigan and 6 are in Wisconsin. Sites may also occur in Ontario.

CLASSIFICATION

Classification Confidence: 2 - Moderate

Global Comments: This type typically occurs as part of a Great Lakes Coastal Wetlands Complex (CECX005702), where it occurs in zones associated with the northern Great Lakes submergent marsh type *Potamogeton gramineus - Potamogeton natans* Northern Great Lakes Shore Herbaceous Vegetation (CEGL005273). It is unclear whether stands in Green Bay area go with this emergent type or with the Southern Great Lakes Emergent Marsh type, *Typha* (cattail) spp. - *Schoenoplectus tabernaemontani* (softstem bulrush) - Mixed Herbs Southern Great Lakes Shore Herbaceous Vegetation (CEGL005112).

Global Similar Associations:

- *Equisetum fluviatile - (Eleocharis palustris)* Herbaceous Vegetation (CEGL005258)
- *Typha* spp. - *Schoenoplectus tabernaemontani* - Mixed Herbs Southern Great Lakes Shore Herbaceous Vegetation (CEGL005112)--southern Great Lakes marsh emergent equivalent.

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Lasso Loop (middle) and on North Manitou Island (Lake Manitou) and South Manitou Island (Florence Lake).

Global Range: This emergent marsh type is found along northern Great Lakes shorelines in Lake Huron, Lake Michigan, Lake Superior and along the St. Clair River in the United States and Canada.

Nations: CA, US

States/Provinces: MI, MN, ON, WI:S4

USFS Ecoregions (1994/95): 212Ho:CCC, 212Hw:CCC, 212I:CC, 212J:CC, 212O:CC, 212:Oa:CCC, 212P:CC

Federal Lands: NPS (Sleeping Bear Dunes)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.51, SLBE.85, SLBE.107.

Sleeping Bear Dunes National Lakeshore Map Code: HEM

Local Description Authors: M.J. Russo

Global Description Authors: D. Faber-Langendoen and D. Albert

References: Midwestern Ecology Working Group n.d., Minc 1996, Minc and Albert 1998, WNHIP unpubl. data

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Midwest Mixed Emergent Deep Marsh

***Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation**
Cattail species - Hardstem Bulrush - Mixed Herbs Midwest Herbaceous Vegetation
Identifier: CEGL002229

NVC CLASSIFICATION

Division	Eastern North America Freshwater Wet Meadow, Riparian & Marsh (2.C.5.Na)
Macrogroup	Eastern North American Wet Meadow & Marsh (M069)
Group	Eastern North American Freshwater Marsh Group (G125)
Association (Common name)	Midwest Mixed Emergent Deep Marsh
Ecological System(s):	Eastern Great Plains Wet Meadow, Prairie and Marsh (CES205.687)
	Laurentian-Acadian Freshwater Marsh (CES201.594)
	North-Central Interior Freshwater Marsh (CES202.899)

ELEMENT CONCEPT

Global Summary: This deep freshwater marsh community is found in glacial potholes, river valleys, ponds, and on lake plains throughout the midwestern and parts of the eastern United States. These marshes have hydric soils and are flooded with water levels ranging from several centimeters to more than 1 m for a significant part of the growing season. Soils that support this community can be mineral or organic but are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. This deepwater emergent marsh community is dominated by perennial, coarse-leaved graminoid vegetation. A typical example of this marsh contains a mosaic of emergents, submergents, and floating-leaved plants interspersed with areas of open water. Occurrences may contain extensive areas of open water, but the vegetation covers at least 3% of the surface. *Typha latifolia* (broadleaf cattail), *Typha angustifolia* (narrowleaf cattail), and *Schoenoplectus acutus* (hardstem bulrush) dominate this dynamic ecosystem. Sedges are also common (e.g., *Carex lupuliformis* (false hop sedge) and *Carex hyalinolepis* (shoreline sedge) in the eastern part of the range), and a diverse assemblage of grasses, floating-leaved aquatics, and submerged aquatics are present. Vegetative diversity and density are highly variable in response to water depth, water chemistry, and natural forces.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This cattail freshwater marsh community was sampled twice in the park. One site is a flat, permanently flooded lakeshore, the other a seasonally flooded, gently sloping, east-facing lakeshore. Soils are very poorly drained muck. The unvegetated surface is dominated by leaf litter (20-90% cover) with some wood (0-5%), bare soil (0-2%), dead plant stems (8-30%), algae and mosses (0-30%) and standing water (0-15%). Evidence of disturbance includes lake level fluctuations, signs of beaver activity and the presence of exotic plants.
Global Environment: These highly productive wetlands are found in glacial potholes, river valleys, ponds, and on lakeplains. They are characterized by continuous inundation and are considered a deep marsh. Water depth averages 0.3-0.6 m, ranging from several centimeters to more than one meter for a significant part of the growing season. Seasonal flooding during winter and spring or flooding during heavy rains help maintain these marshes by causing water exchange which replenishes freshwater and circulates nutrients and organic debris. Soils can be mineral or organic but are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. Vegetative diversity and density are highly variable in response to water depth, water chemistry, and natural forces.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: This moderately to very densely vegetated (50-100% cover) herbaceous community, 1-2 m tall, is dominated by either *Typha angustifolia* (narrowleaf cattail) or *Typha latifolia* (broadleaf cattail); one stand is codominated by *Phragmites australis* (common reed). Additional graminoids include *Calamagrostis canadensis* (bluejoint), *Carex aquatilis* (water sedge), *Carex comosa* (longhair sedge), *Juncus effusus* (common rush), *Leersia oryzoides* (rice cutgrass), *Phalaris arundinacea* (reed canarygrass), and *Schoenoplectus acutus* var. *acutus* (hardstem bulrush). Forbs include *Bidens cernua* (nodding beggarticks), *Bidens connata* (purplestem beggarticks), *Cicuta bulbifera* (bulblet-bearing water hemlock), *Lycopus uniflorus* (northern bugleweed), *Mentha arvensis* (wild mint), *Pilea pumila* (Canadian clearweed), *Sparganium erectum* ssp. *stoloniferum* (simplestem bur-reed), and *Symphyotrichum lateriflorum* (calico aster). Aquatic plants include *Ceratophyllum demersum* (coon's-tail), *Lemna minor* (common duckweed), *Nymphaea odorata* (American white waterlily), and *Spirodela polyrrhiza* (common duckmeat).
Global Vegetation: This deepwater emergent marsh community is dominated by perennial herbaceous vegetation with graminoid leaves. A typical example of this marsh contains a mosaic of emergents, submergents, and floating-leaved plants interspersed with areas of open water (Harris et al. 1996). Various kinds of emergents may dominate a marsh depending on the water depth. Quite often the vegetation arranges itself in belts (wetland zonation), with a particular species or range of species occupying specific depths from the shoreline to deep open water. Marshes may display areas of open water, but vegetation dominates (>30% cover). *Typha latifolia* (broadleaf cattail), *Typha angustifolia* (narrowleaf cattail), and *Schoenoplectus acutus* (hardstem bulrush) dominate this dynamic ecosystem. Sedges are also common (e.g., *Carex lupuliformis* (false hop sedge) and *Carex hyalinolepis* (shoreline sedge) in the eastern part of the range). A diverse assemblage of grasses, floating-leaved aquatics, and submerged aquatics are present (TNC 1995a).

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MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Carex comosa* (longhair sedge), *Phragmites australis* (common reed), *Typha angustifolia* (narrowleaf cattail), *Typha latifolia* (broadleaf cattail)

Global

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Carex hyalinolepis* (shoreline sedge), *Phragmites australis* (common reed), *Schoenoplectus acutus* (hardstem bulrush), *Typha latifolia* (broadleaf cattail)
Floating aquatic	Aquatic herb (floating & submergent)	*Lemna minor* (common duckweed)
Submerged aquatic	Aquatic herb (floating & submergent)	*Nelumbo lutea* (American lotus)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Carex aquatilis* (water sedge), *Carex comosa* (longhair sedge), *Phragmites australis* (common reed), *Typha angustifolia* (narrowleaf cattail), *Typha latifolia* (broadleaf cattail)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Agrostis gigantea* (redtop, exotic, Medium/Low), *Typha angustifolia* (narrowleaf cattail, exotic, High/Medium)
Global: Vulnerable: *Calephelis muticum* (swamp metalmark, G3), *Cryptobranchus alleganiensis* (hellbender, G3G4); **Exotic/Invasive**: *Lythrum salicaria* (purple loosestrife, an aggressive exotic species which threatens this community in Canada, the northeast, and more recently in the midwest., High); **Other**: *Acris gryllus* (southern cricket frog, G5), *Agkistrodon piscivorus* (cottonmouth, G5), *Aix sponsa* (wood duck, G5), *Ambystoma maculatum* (spotted salamander, G5), *Ambystoma tigrinum* (tiger salamander, G5), *Anas acuta* (northern pintail, G5), *Anas americana* (american wigeon, G5), *Anas clypeata* (northern shoveler, G5), *Anas crecca* (green-winged teal, G5), *Anas discors* (blue-winged teal, G5), *Anas platyrhynchos* (mallard, G5), *Anas strepera* (gadwall, G5), *Ardea alba* (great egret, G5), *Ardea herodias* (great blue heron, G5), *Aythya affinis* (lesser scaup, G5), *Aythya americana* (redhead, G5), *Aythya collaris* (ring-necked duck, G5), *Aythya valisineria* (canvasback, G5), *Botaurus lentiginosus* (american bittern, G4), *Branta canadensis* (canada goose, G5), *Bubulcus ibis* (cattle egret, G5), *Bucephala clangula* (common goldeneye, G5), *Butorides virescens* (green heron, G5), *Chen caerulescens* (snow goose, G5), *Chlidonias niger* (black tern, G4), *Chrysemys picta* (northern painted turtle, G5), *Cistothorus palustris* (marsh wren, G5), *Cistothorus platensis* (sedge wren, G5), *Drosophila melanogaster* (vinegar fly, GNR), *Fulica americana* (american coot, G5), *Gallinula chloropus* (common moorhen, G5), *Gambusia affinis* (western mosquitofish, G5), *Himantopus mexicanus* (black-necked stilt, G5), *Hydroprogne caspia* (caspian tern, G5), *Ictinia mississippiensis* (mississippi kite, G5), *Ixobrychus exilis* (least bittern, G5), *Lontra canadensis* (north american river otter, G5), *Lycaena xanthoides* (great copper, G4), *Melospiza georgiana* (swamp sparrow, G5), *Mergus merganser* (common merganser, G5), *Necturus maculosus* (mudpuppy, G5), *Neovison vison* (american mink, G5), *Nerodia sipedon* (northern watersnake, G5), *Ondatra zibethicus* (common muskrat, G5), *Orconectes lancifer* (shrimp crayfish, G5), *Oryzomys palustris* (marsh oryzomys, G5), *Oxyura jamaicensis* (ruddy duck, G5), *Porphyrio martinica* (purple gallinule, G5), *Porzana carolina* (sora, G5), *Procyon lotor* (raccoon, G5), *Pseudacris crucifer* (spring peeper, G5), *Pseudacris nigrita* (southern chorus frog, G5), *Pseudacris streckeri* (strecker's chorus frog, G5), *Rallus elegans* (king rail, G4), *Rallus limicola* (virginia rail, G5), *Rallus longirostris* (clapper rail, G5), *Rana catesbeiana* (american bullfrog, G5), *Rana clamitans* (green frog, G5), *Rana pipiens* (northern leopard frog, G5), *Recurvirostra americana* (american avocet, G5), *Schoenoplectus californicus* (California bulrush, occasionally found in this community, G5), *Sterna forsteri* (forster's tern, G5), *Sylvilagus palustris* (marsh rabbit, G5), *Tringa semipalmata* (willet, G5), *Xanthocephalus xanthocephalus* (yellow-headed blackbird, G5)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4? (26-Jan-2000). This type is subject to many forms of human impact, particularly draining for farmland.

CLASSIFICATION

Classification Confidence: 2 - Moderate
Global Comments: This community type is very broadly defined. It can be highly dynamic from one season to the next, and species composition and density are very dependent on water regime and sometimes the mineral content of water and soil (Niering 1985). Deep marsh is defined as having water depths of 15 cm to over 1 m throughout all or most of the growing season (Shaw and Fredine 1971, in Eggers and Reed 1987). The concept and distribution of this community in the Southeast needs reassessment; it should be compared to *Typha latifolia* (broadleaf cattail) Southern Herbaceous Vegetation (CEGL004150), particularly in the Mississippi alluvial plain of Missouri (M. Leahy pers. comm. 1999). Many of the presettlement occurrences of this community have been drained and converted to cropland or destroyed by siltation, which greatly accelerates the natural successional process from shallow inundation to moist soil. *Lythrum salicaria* (purple loosestrife) is an aggressive exotic species that threatens this community in Canada, the Northeast, and more recently in the Midwest. Stands in Province 212 may deserve to be recognized as a separate northern type, but further data are needed.

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Global Similar Associations:
- *Schoenoplectus acutus - Typha latifolia - (Schoenoplectus tabernaemontani)* Sandhills Herbaceous Vegetation (CEGL002030)
- *Schoenoplectus acutus* Herbaceous Vegetation (CEGL001840)
- *Schoenoplectus tabernaemontani - Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026)
- *Typha (angustifolia, latifolia) - (Schoenoplectus* spp.) Eastern Herbaceous Vegetation (CEGL006153)
- *Typha latifolia - Caltha palustris* Herbaceous Vegetation (CEGL006245)
- *Typha latifolia* Southern Herbaceous Vegetation (CEGL004150)
- *Typha* spp. Midwest Herbaceous Vegetation (CEGL002233)

Global Related Concepts:
- Freshwater Marsh (Steinauer and Rolfsmeier 2003) B
- Freshwater Marsh (Nelson 1985) B
- Freshwater Marsh (Steinauer and Rolfsmeier 2000) =
- Inland Emergent Marsh (Chapman et al. 1989) B
- Marsh: Mixed: Mineral Substrate (W5) (Harris et al. 1996) B
- Marsh: Mixed: Organic Substrate (W10) (Harris et al. 1996) B
- Palustrine Emergent Wetland (Cowardin et al. 1979) F
- Palustrine: Herbaceous Wetland: Riparian (TNC 1985) B
- Palustrine: Palustrine Emergent Wetland (Cowardin et al. 1979) F
- Pond Marsh (Steinauer and Rolfsmeier 2003) B
- UNESCO FORMATION CODE: V.A. (UNESCO 1973) B

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled at Narada Lake and on South Manitou Island (Florence Lake).

Global Range: This community is found in glacial potholes, river valleys, ponds, and on lakeplains throughout the midwestern and parts of the eastern United States, ranging from Ohio and Ontario west to North Dakota, south to Nebraska and east to Alabama.

Nations: CA, US

States/Provinces: AL, IA:S4, IL, IN, KY, MI, MN, MO, ND, NE, OH, ON, SD, TN, WI:S4, WY

USFS Ecoregions (1994/95): 212He:CCC, 212Hi:CCC, 212Hj:CCP, 212Ho:CCC, 212Hq:CCP, 212Ht:CCC, 212Hv:CCC, 212Hw:CCC, 212Ib:C??, 212Ja:CPP, 212Jb:CP?, 212Jc:CP?, 212Jf:CPP, 212Jj:CPP, 212Jl:CPP, 212Jm:CPP, 212Jn:CP?, 212Jo:CP?, 212Ka:CPP, 212Mb:CPP, 212Na:CCP, 212Nb:CCP, 212Nc:CCC, 212Nd:CC?, 212:Oa:CCC, 222A:CP, 222D:CP, 222E:CP, 222G:CP, 222Ha:CCC, 222Hb:CCC, 222Ia:CCC, 222Jc:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222Jj:CCC, 222Kd:CCC, 222Ke:CCC, 222Kf:CCC, 222Kg:CCC, 222Kj:CCC, 222Mc:CCC, 222Md:CCC, 222Me:CCC, 222Na:CCC, 234A:PP, 251Aa:CCC, 251Ab:CCC, 251Bb:CCC, 251Bd:CCC, 251Be:CCC, 251Cb:CCC, 251Cf:CCC, 251Cg:CCC, 251Ch:CCC, 251Cm:CCC, 251Cp:CCC, 251Dg:CCC, 251Eb:CCC

Federal Lands: NPS (Isle Royale, Pictured Rocks, Sleeping Bear Dunes); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron, Huron-Manistee, Nicolet, Ottawa?)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.73, SLBE.86.

Sleeping Bear Dunes National Lakeshore Map Code: HCM

Local Description Authors: M.J. Russo

Global Description Authors: M. Guetersloh, mod. D. Faber-Langendoen

References: Benyus 1989, Chapman et al. 1989, Cowardin et al. 1979, Duncan and Duncan 1988, Eggers and Reed 1987, Faircloth 1971, Fehrenbacher et al. 1982, Harris et al. 1996, INAI unpubl. data, Illinois Nature Preserve Commission 1973, Midwestern Ecology Working Group n.d., Mitsch and Gosselink 1993, Mohlenbrock 1959, NDNHI unpubl. data, Nelson 1985, Niering 1985, Schotz pers. comm., Shaw and Fredine 1971, Steinauer and Rolfsmeier 2000, Steinauer and Rolfsmeier 2003, TDNH unpubl. data, TNC 1985, TNC 1995a, UNESCO 1973, WNHIP unpubl. data, Wharton 1978, Wharton 1989, White and Madany 1978, Whitley et al. 1990

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G112. Eastern North American Wet Meadow Group

Bluejoint Wet Meadow

***Calamagrostis canadensis - Eupatorium maculatum* Herbaceous Vegetation**
Bluejoint - Spotted Joe-pyeweed Herbaceous Vegetation
Identifier: CEGL005174

NVC CLASSIFICATION

Division	Eastern North America Freshwater Wet Meadow, Riparian & Marsh (2.C.5.Na)
Macrogroup	Eastern North American Wet Meadow & Marsh (M069)
Group	Eastern North American Wet Meadow Group (G112)
Association (Common name)	Bluejoint Wet Meadow
Ecological System(s):	Eastern Great Plains Wet Meadow, Prairie and Marsh (CES205.687)
	Eastern Boreal Floodplain (CES103.588)
	North-Central Interior Wet Meadow-Shrub Swamp (CES202.701)
	Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582)
	Central Appalachian River Floodplain (CES202.608)
	High Allegheny Wetland (CES202.069)

ELEMENT CONCEPT

Global Summary: This wet meadow vegetation is widespread in the northeastern and midwestern United States and central and eastern Canada. Stands occur on the floodplains of small streams, in poorly drained depressions, beaver meadows, levees and lakeshores. Soils are typically mineral soil or well-decomposed peat, with a thick root mat. Water regime varies between temporarily and seasonally flooded. Graminoid cover is typically dense and can form hummocky microtopography. *Calamagrostis canadensis* (bluejoint) is dominant, often occurring in almost pure stands or with tall sedges, such as *Carex aquatilis* (water sedge), *Carex lacustris* (hairy sedge), *Carex utriculata* (Northwest Territory sedge), and *Carex stricta* (upright sedge). In fen transitions, *Carex lasiocarpa* (woollyfruit sedge) can be present. *Agrostis gigantea* (redtop), *Glyceria grandis* (American mannagrass), *Poa palustris* (fowl bluegrass), *Poa compressa* (Canada bluegrass), *Scirpus cyperinus* (woolgrass), and *Typha latifolia* (broadleaf cattail) are sometimes abundant. Forbs include *Campanula aparinoides* (marsh bellflower), *Epilobium leptophyllum* (bog willowherb), *Eupatorium maculatum* (spotted joepyeweed), *Eupatorium perfoliatum* (common boneset), *Impatiens capensis* (jewelweed), *Iris versicolor* (harlequin blueflag), *Polygonum amphibium* (water knotweed), and *Comarum palustre* (purple marshlocks). Scattered shrubs, such as *Viburnum nudum* (possumhaw), *Viburnum dentatum* (southern arrow-wood), *Spiraea alba* (white meadowsweet), *Cornus amomum* (silky dogwood), *Alnus incana* (gray alder), or *Alnus serrulata* (hazel alder), may be present. *Phalaris arundinacea* (reed canarygrass) and/or *Lythrum salicaria* (purple loosestrife) may be present, especially in disturbed examples.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This wet grassland vegetation was sampled at four locations in the park. Sites are flat, intermittently to seasonally flooded lakeplains, depressions and swales with poorly drained peat or sandy loam or moderately well-drained sandy clay loam soils. The unvegetated surface is dominated by leaf litter (80-90% cover) with some wood (0-10%), bare soil (0-5%) and dead plant stems (5-40%). Evidence of disturbance includes areas of heavy deer browse, dead standing trees, tree/shrub encroachment and the presence of exotic plants.

Global Environment: Stands occur on the floodplains of small streams, in poorly drained depressions, beaver meadows, levees and lakeshores. Soils are typically mineral soil or well-decomposed peat or peat silt loam with a thick root mat. Water regime varies between temporarily and seasonally flooded.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: This densely vegetated (80-100% cover) herbaceous community is dominated by either *Calamagrostis canadensis* (bluejoint) or *Phalaris arundinacea* (reed canarygrass). Additional herbs may include *Carex retrorsa* (knotsheath sedge), *Comandra umbellata* (bastard toadflax), *Eupatorium perfoliatum* (common boneset), *Euthamia graminifolia* (flat-top goldentop), *Glyceria borealis* (small floating mannagrass), *Linnaea borealis* (twinflower), *Lobelia kalmii* (Ontario lobelia), *Lycopus uniflorus* (northern bugleweed), *Mentha arvensis* (wild mint), *Muhlenbergia mexicana* (Mexican muhly), *Packera paupercula* (balsam groundsel), *Pteridium aquilinum* (western brackenfern), *Scirpus atrovirens* (green bulrush), *Scirpus cyperinus* (woolgrass), *Solidago canadensis* (Canada goldenrod), *Symphyotrichum lanceolatum* (white panicle aster), and others. In addition, there may be a few scattered shrubs, including *Betula alleghaniensis* (yellow birch), *Cornus amomum* (silky dogwood), *Pinus banksiana* (jack pine), *Populus tremuloides* (quaking aspen), *Rubus hispidus* (bristly dewberry), *Rubus idaeus* ssp. *strigosus* (grayleaf red raspberry), and *Salix myricoides* (bayberry willow).

Global Vegetation: Graminoid cover is typically dense and can form hummocky microtopography. *Calamagrostis canadensis* (bluejoint) is dominant, often occurring in almost pure stands or with tall sedges, such as *Carex aquatilis* (water sedge), *Carex lacustris* (hairy sedge), *Carex rostrata* (beaked sedge), and *Carex stricta* (upright sedge). In fen transitions, *Carex lasiocarpa* (woollyfruit sedge) can be present. *Agrostis gigantea* (redtop), *Glyceria grandis* (American mannagrass), *Poa palustris* (fowl bluegrass), *Poa compressa* (Canada bluegrass), *Scirpus cyperinus* (woolgrass), and *Typha latifolia* (broadleaf cattail) are sometimes abundant. Forbs include *Campanula aparinoides* (marsh bellflower), *Epilobium leptophyllum* (bog willowherb), *Eupatorium maculatum* (spotted joepyeweed), *Eupatorium perfoliatum* (common boneset), *Iris versicolor* (harlequin blueflag), *Polygonum*

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amphibium (water knotweed), and *Comarum palustre* (purple marshlocks). Scattered shrubs, such as *Viburnum nudum* (possumhaw), *Viburnum dentatum* (southern arrow-wood), *Spiraea alba* (white meadowsweet), *Cornus amomum* (silky dogwood), *Alnus incana* (gray alder), or *Alnus serrulata* (hazel alder), may be present. *Lythrum salicaria* (purple loosestrife) may be present, especially in disturbed examples.

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Calamagrostis canadensis* (bluejoint), *Phalaris arundinacea* (reed canarygrass)

Global

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Calamagrostis canadensis* (bluejoint)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Calamagrostis canadensis* (bluejoint), *Glyceria borealis* (small floating mannagrass), *Lycopus uniflorus* (northern bugleweed), *Phalaris arundinacea* (reed canarygrass), *Scirpus cyperinus* (woolgrass)
Global: *Calamagrostis canadensis* (bluejoint)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Solanum dulcamara* (climbing nightshade, exotic, Low)
Global: Vulnerable: *Polemonium vanbruntiae* (Vanbrunt's polemonium, G3G4)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (31-Mar-2000). This type is widespread throughout the northeastern and upper midwestern United States and central/southern Canada.

CLASSIFICATION

Classification Confidence: 2 - Moderate
Global Comments: This type can grade into sedge meadows. A guideline of <50% sedges may be suggested as a criterion for the definition of this type compared to sedge meadow types. Harris et al. (1996) suggest that the bluejoint meadow type is drier than sedge meadows and less peaty than shore fens.
Global Similar Associations:
- *Calamagrostis canadensis - Doellingeria umbellata - Spartina pectinata* Herbaceous Vegetation (CEGL006427)
- *Calamagrostis canadensis - Scirpus* spp. - *Dulichium arundinaceum* Herbaceous Vegetation (CEGL006519)
- *Carex (rostrata, utriculata) - Carex lacustris - (Carex vesicaria)* Herbaceous Vegetation (CEGL002257)
- *Carex stricta - Carex* spp. Herbaceous Vegetation (CEGL002258)--Dominance of sedges versus grasses is much higher.
- *Phalaris arundinacea* Eastern Herbaceous Vegetation (CEGL006044)
- *Phalaris arundinacea* Western Herbaceous Vegetation (CEGL001474)
- *Phleum pratense - (Calamagrostis canadensis)* Semi-natural Herbaceous Vegetation (CEGL005249)

Global Related Concepts:
- *Calamagrostis canadensis* herbaceous community (Walbridge and Lang 1982) =
- *Calamagrostis canadensis* meadow (Walbridge 1982) =
- *Calamagrostis canadensis* wet meadow (Fortney 1975) =
- Bluejoint Meadow (Gawler 2002) B
- Canada bluejoint-tussock sedge meadow (CAP pers. comm. 1998) ?
- Meadow marsh: bluejoint grass (W13) (Harris et al. 1996) =
- Palustrine Persistent Emergent Wetland (PEM1) (Cowardin et al. 1979) ?
- SNE low-energy riverbank community (Rawinski 1984) ?
- Shallow Emergent Marsh (Thompson 1996) ?
- Wet Meadow (Harrison 2004) B

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Old Indian Trail (Black Arrow Loop), on the southern dunes at the mount of the Platte River and on North Manitou Island.
Global Range: This wet meadow vegetation is widely distributed in the northeastern and midwestern United States and south-central and southeastern Canada. It ranges from Maine south to West Virginia and possibly Virginia and west to Minnesota.
Nations: CA, US
States/Provinces: CT, DE, MA, MD, ME, MI, MN, NH, NJ, NY, ON, PA, QC:S4?, RI, VA?, VT, WI, WV:S2
USFS Ecoregions (1994/95): 212Cb:CCC, 212Fa:CCC, 212Fb:CCC, 212Fc:CCC, 212Fd:CCC, 212Ga:CCC, 212Gb:CCC, 212Hi:CCC, 212Hj:CCC, 212Ho:CCC, 212Hs:CCC, 212Hw:CCC, 212Hx:CCC, 212Ia:CCC, 212Ib:CCC, 212La:CCP, 212Lb:CCC, 212Na:CPP, 212:Oa:CCC, 221Ae:CCP, 221Af:CCC, 221Ag:CCC, 221Ah:CCC, 221Ai:CCC, 221Al:CCC, 221Ba:CCP, 221Bb:CCC, 221Bc:CCP, 221Bd:CCC, 221D:CC, 222Jg:CCC, 222Na:CCC, 251Aa:CCC, M212Bb:CCC, M212Bc:CCC, M212Bd:CCC, M212Cb:CCC, M212Ea:CCC, M212Eb:CCC, M221Ba:CCC, M221Bb:CCC, M221Db:C??, M221Dc:C??, M221Dd:C??

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Federal Lands: NPS (Apostle Islands, Grand Portage, Isle Royale, Minute Man, Pictured Rocks, Saint Croix, Saint-Gaudens, Sleeping Bear Dunes, Valley Forge, Voyageurs); USFS (Monongahela); USFWS (Assabet River?, Canaan Valley, Great Meadows?)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.29, SLBE.81, SLBE.108, SLBE.109.

Sleeping Bear Dunes National Lakeshore Map Code: HCC

Local Description Authors: M.J. Russo

Global Description Authors: S.C. Gawler

References: Breden et al. 2001, Browning 1859, Byers et al. 2007, CAP pers. comm. 1998, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Fike 1999, Fortney 1975, Francl et al. 2004, Gawler 2002, Harris et al. 1996, Harrison 2004, NAP pers. comm. 1998, Rawinski 1984, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000, WNHIP unpubl. data, Walbridge 1982, Walbridge and Lang 1982

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Northern Sedge Wet Meadow

***Carex (rostrata, utriculata) - Carex lacustris - (Carex vesicaria)* Herbaceous Vegetation**
(Beaked Sedge, Northwest Territory Sedge) - Lake Sedge - (Inflated Sedge) Herbaceous Vegetation
Identifier: CEGL002257

NVC CLASSIFICATION

Division	Eastern North America Freshwater Wet Meadow, Riparian & Marsh (2.C.5.Na)
Macrogroup	Eastern North American Wet Meadow & Marsh (M069)
Group	Eastern North American Wet Meadow Group (G112)
Association (Common name)	Northern Sedge Wet Meadow
Ecological System(s):	Eastern Great Plains Wet Meadow, Prairie and Marsh (CES205.687)
	North-Central Interior Wet Meadow-Shrub Swamp (CES202.701)
	Northern Great Lakes Coastal Marsh (CES201.722)
	Western Great Plains Open Freshwater Depression Wetland (CES303.675)
	North-Central Interior Floodplain (CES202.694)
	Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582)
	High Allegheny Wetland (CES202.069)

ELEMENT CONCEPT

Global Summary: This northern tall sedge community is found in the mixed conifer - hardwood zone of the Great Lakes region and north into Canada, with outliers in the Allegheny Mountains region of West Virginia and Maryland. Sites are found on floodplains, shallow bays of lakes and streams, beaver meadows, ditches, and occasionally in isolated basins, or on semi-floating mats. Hydrology is seasonally to semipermanently flooded. Substrate is mineral soil or well-decomposed peat. Tall coarse-leaved sedges dominate the vegetation layer, often creating a tussocky hummock microtopography. Shrubs can cover up to 25% of the area. Pools with submergents may also be present. Dominant graminoids include a number of Carices, including *Carex aquatilis* (water sedge), *Carex lacustris* (hairy sedge), *Carex lasiocarpa* (woollyfruit sedge), *Carex rostrata* (beaked sedge), *Carex utriculata* (Northwest Territory sedge), *Carex vesicaria* (blister sedge), and locally *Carex stricta* (upright sedge). Other graminoids include *Calamagrostis canadensis* (bluejoint), *Scirpus atrovirens* (green bulrush), *Scirpus cyperinus* (woolgrass), and in wetter areas, *Eleocharis palustris* (common spikerush) and *Equisetum fluviatile* (water horsetail). Forbs include *Acorus calamus* (calamus), *Symphyotrichum lanceolatum* var. *lanceolatum* (white panicle aster), *Campanula aparinoides* (marsh bellflower), *Eupatorium maculatum* (spotted joepyeweed), *Iris virginica* var. *shrevei* (Shreve's iris), *Lycopus uniflorus* (northern bugleweed), *Poa palustris* (fowl bluegrass), *Polygonum amphibium* (water knotweed), *Comarum palustre* (purple marshlocks), and others. Diagnostic features include the general dominance by coarse-leaved sedges, wet, somewhat peaty soil conditions, and the mix of sub-boreal herbs with more temperate herbs.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This northern tall sedge wetland community was sampled at four locations in the park. Sites are flat, saturated to intermittently or seasonally flooded lakeplains and depressions with very poorly to poorly drained peat, muck and sand soils. The unvegetated surface is dominated by leaf litter (15-85% cover), bare sand (0-78%) or dead plant stems (5-80%) with some small rocks (0-1%) and wood (0-1%). Evidence of disturbance includes trails, signs of beaver activity and the presence of exotic plants.

Global Environment: Sites are found on floodplains, shallow bays of lakes and streams, beaver meadows, ditches, and occasionally in isolated basins, or on semi-floating mats. Hydrology is seasonally to semipermanently flooded. Substrate is mineral soil or well-decomposed peat (Curtis 1959, Harris et al. 1996).

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: This sparsely to densely vegetated (10-100% cover) herbaceous community is defined by the presence of *Carex* (sedge) spp., including *Carex crinita* (fringed sedge), *Carex flava* (yellow sedge), *Carex lacustris* (hairy sedge), and *Carex viridula* (little green sedge). Additional graminoids may include *Calamagrostis canadensis* (bluejoint), *Cladium mariscoides* (smooth sawgrass), *Dulichium arundinaceum* (threeway sedge), *Eleocharis elliptica* (elliptic spikerush), *Juncus pelocarpus* (brownfruit rush), *Phragmites australis* (common reed), *Schoenoplectus acutus* (hardstem bulrush), and *Scirpus cyperinus* (woolgrass). Forbs may include *Agalinis purpurea* (purple false foxglove), *Eupatorium perfoliatum* (common boneset), *Impatiens capensis* (jewelweed), *Iris virginica* (Virginia iris), *Lycopus uniflorus* (northern bugleweed), *Polygonum amphibium* (water knotweed), *Scutellaria lateriflora* (blue skullcap), *Triadenum fraseri* (Fraser's marsh St. Johnswort), and others. Ferns include *Onoclea sensibilis* (sensitive fern), *Osmunda regalis* (royal fern), and *Thelypteris palustris* (eastern marsh fern). In addition, there may be a few scattered shrubs of *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Chamaedaphne calyculata* (leatherleaf), *Rosa palustris* (swamp rose), and/or *Salix myricoides* (bayberry willow).

Global Vegetation: Tall coarse-leaved sedges dominate the vegetation layer, often creating a tussocky hummock microtopography. Shrubs can cover up to 25% of the area. Pools with submergents may also be present. Dominant graminoids include a number of Carices, including *Carex aquatilis* (water sedge), *Carex lacustris* (hairy sedge), *Carex lasiocarpa* (woollyfruit sedge), *Carex rostrata* (beaked sedge), *Carex vesicaria* (blister sedge), and locally *Carex stricta* (upright sedge). Other graminoids include *Calamagrostis canadensis* (bluejoint), *Scirpus atrovirens* (green bulrush), *Scirpus cyperinus* (woolgrass), and in wetter areas, *Eleocharis palustris* (common spikerush) and *Equisetum fluviatile* (water horsetail). Forbs include *Acorus calamus* (calamus), *Symphyotrichum*

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lanceolatum var. *lanceolatum* (white panicle aster), *Campanula aparinoides* (marsh bellflower), *Eupatorium maculatum* (spotted joepyeweed), *Iris virginica* var. *shrevei* (Shreve's iris), *Lycopus uniflorus* (northern bugleweed), *Poa palustris* (fowl bluegrass), *Polygonum amphibium* (water knotweed), *Comarum palustre* (purple marshlocks), and others (Curtis 1959, Harris et al. 1996).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Calamagrostis canadensis* (bluejoint), *Carex flava* (yellow sedge), *Carex lacustris* (hairy sedge), *Dulichium arundinaceum* (threeway sedge)
Herb (field)	Fern or fern ally	*Thelypteris palustris* (eastern marsh fern)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Calamagrostis canadensis* (bluejoint), *Carex flava* (yellow sedge), *Carex lacustris* (hairy sedge), *Cladium mariscoides* (smooth sawgrass), *Dulichium arundinaceum* (threeway sedge), *Lycopus uniflorus* (northern bugleweed), *Schoenoplectus acutus* var. *acutus* (hardstem bulrush), *Thelypteris palustris* (eastern marsh fern)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Agrostis gigantea* (redtop, exotic, Medium/Low)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (17-Jun-1999).

CLASSIFICATION

Classification Confidence: 2 - Moderate

Global Comments: Expansion of the range of this type eastward to Massachusetts and West Virginica is based on the ambiguous application of *Carex utriculata* (Northwest Territory sedge) in past studies. Taxonomy and distribution of *Carex utriculata* (Northwest Territory sedge) versus *Carex rostrata* (beaked sedge) needs to be resolved. In Gleason and Cronquist (1991), *Carex rostrata* (beaked sedge) is circumboreal and only occurs in northern Michigan and northern Minnesota, whereas *Carex utriculata* (Northwest Territory sedge) is boreal but extends south to Delaware, Indiana, Nebraska, New Mexico and California. (*Carex vesicaria* (blister sedge) has a similar distribution to *Carex utriculata* (Northwest Territory sedge).) *Carex rostrata* (beaked sedge) has also been reported from extreme northern Wisconsin, e.g., on the Apostle Islands (E. Judziewicz pers. comm. 1999). However, all of the atlases and floras in the Midwest (Voss 1972, Mohlenbrock and Ladd 1978, Ownbey and Morley 1991) do not make such a distinction, so the species are essentially treated as synonymous in this type. Curtis (1959) suggested that differential species for northern sedge meadows in Wisconsin may be *Symphyotrichum puniceum* (purplestem aster), *Campanula aparinoides* (marsh bellflower), *Glyceria canadensis* (rattlesnake mannagrass), *Scirpus atrovirens* (green bulrush), and *Solidago uliginosa* (bog goldenrod), among others, but this list needs further study.

Global Similar Associations:

- *Calamagrostis canadensis - Eupatorium maculatum* Herbaceous Vegetation (CEGL005174)--This type is more heavily grass- and forb-dominated, sedges <25%?
- *Carex aquatilis - Carex utriculata* Herbaceous Vegetation (CEGL001803)
- *Carex lacustris* Herbaceous Vegetation (CEGL002256)
- *Carex stricta - Carex* spp. Herbaceous Vegetation (CEGL002258)
- *Chamaedaphne calyculata / Carex oligosperma / Sphagnum* spp. Dwarf-shrubland (CEGL005091)
- *Cornus sericea - Salix (bebbiana, discolor, petiolaris) / Calamagrostis stricta* Shrubland (CEGL002187)
- *Eriophorum virginicum - (Carex folliculata) / Sphagnum* spp. *- Polytrichum* spp. Herbaceous Vegetation (CEGL006570)
- *Myrica gale - Chamaedaphne calyculata / Carex (lasiocarpa, utriculata) - Utricularia* spp. Shrub Herbaceous Vegetation (CEGL006302)

Global Related Concepts:

- *Carex rostrata - Rubus hispidus - Pyrus melanocarpa* community (Edens 1973) =
- *Carex rostrata - Sphagnum* spp. community (Darlington 1943) =
- *Carex rostrata* sedge-meadow community (Robinette 1966) =
- *Polytrichum - Carex (rostrata, stricta)* hummock bog (Fortney 1975) =
- Calcareous Spring Marsh / Muck Fen (Fleming et al. 2001) B
- Meadow marsh: tall sedge (W12) (Harris et al. 1996) =
- Mixed Tall Sedge Fen (Gawler 2002) B
- Northern Sedge Meadow (Curtis 1959) =

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Peterson Road and on North Manitou Island (Tamarack Lake and Svenson's Barn area) and South Manitou Island (Florence Lake).

Global Range: This northern tall sedge community is found in the mixed conifer - hardwood zone of the Great Lakes and northeastern region of the United States and north into Canada, extending from Maine to Manitoba, south to Michigan and Iowa.

Nations: CA, US

States/Provinces: IA, MB:SU, ME, MI, MN, ND:S2S3, ON, QC:S4?, SD, VA?, WI:S3, WV:S2, WY

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USFS Ecoregions (1994/95): 212Ha:CCP, 212Hb:CCP, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCC, 212Hk:CCP, 212Hn:CCP, 212Ho:CCC, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hv:CCC, 212Hw:CCC, 212Hx:CCP, 212Hy:CCP, 212Ia:CCC, 212Ib:CCP, 212Ja:CCP, 212Jb:CCP, 212Jc:CCP, 212Jd:CCC, 212Je:CC?, 212Jf:CCP, 212Jj:CCP, 212Jk:CCP, 212Jl:CCP, 212Jm:CCP, 212Jn:CCP, 212Jo:CCP, 212Jr:CCP, 212Ka:CCC, 212La:CCP, 212Lb:CCC, 212Lc:CCP, 212Ld:CCP, 212Mb:CPP, 212Na:CPP, 212Nb:CPP, 212Nc:CPP, 212:Oa:CCC, 222Lb:CCC, 251Ab:CCC, 251B:CC, 332:?

Federal Lands: NPS (Apostle Islands, Grand Portage, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Hiawatha, Huron, Huron-Manistee, Manistee, Monongahela, Nicolet, Ottawa?, Superior?); USFWS (Canaan Valley)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.53, SLBE.83, SLBE.112, SLBE.114.

Sleeping Bear Dunes National Lakeshore Map Code: HSG

Local Description Authors: M.J. Russo

Global Description Authors: D. Faber-Langendoen, mod. E.A. Byers

References: Byers et al. 2007, Curtis 1959, Damman and French 1987, Darlington 1943, Edens 1973, Fleming et al. 2001, Fortney 1975, Fortney and Rentch 2003, Francl et al. 2004, Gawler 2002, Gleason and Cronquist 1991, Greenall 1996, Harris et al. 1996, INAI unpubl. data, Midwestern Ecology Working Group n.d., Mohlenbrock and Ladd 1978, NDNHI unpubl. data, Ownbey and Morley 1991, Robinette 1966, Voss 1972, WNHIP unpubl. data

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Upright Sedge Wet Meadow

***Carex stricta* - *Carex* spp. Herbaceous Vegetation**
Upright Sedge - Sedge species Herbaceous Vegetation
Identifier: CEGL002258

NVC CLASSIFICATION

Division	Eastern North America Freshwater Wet Meadow, Riparian & Marsh (2.C.5.Na)
Macrogroup	Eastern North American Wet Meadow & Marsh (M069)
Group	Eastern North American Wet Meadow Group (G112)
Association (Common name)	Upright Sedge Wet Meadow
Ecological System(s):	Eastern Great Plains Wet Meadow, Prairie and Marsh (CES205.687)
	North-Central Interior Wet Meadow-Shrub Swamp (CES202.701)
	Western Great Plains Open Freshwater Depression Wetland (CES303.675)
	Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582)

ELEMENT CONCEPT

Global Summary: This wet sedge meadow community is found in the southern Great Lakes region and parts of the central midwestern United States. Sites occur in stream valleys, along lake margins, and in depressions and channels in glacial outwash. Soils include wet mineral soils, muck, or shallow peat (<0.5 m), with the water table below the surface for most of the growing season. The vegetation is dominated by sedges and grasses, but the shrub component can be high as 25%. Dominant plants include *Calamagrostis canadensis* (bluejoint) and *Carex stricta* (upright sedge). Associated graminoids include *Carex aquatilis* (water sedge), *Carex pellita* (woolly sedge), *Carex bebbii* (Bebb's sedge), *Carex lacustris* (hairy sedge), *Eleocharis* (spikerush) spp., *Juncus* (rush) spp., *Phalaris arundinacea* (reed canarygrass) (common in more degraded examples), and *Typha latifolia* (broadleaf cattail). Typical forbs include *Anemone canadensis* (Canadian anemone), *Asclepias incarnata* (swamp milkweed), *Symphyotrichum lanceolatum* var. *lanceolatum* (white panicle aster), *Equisetum arvense* (field horsetail), *Eupatorium maculatum* (spotted joepyeweed), *Eupatorium perfoliatum* (common boneset), *Iris versicolor* (harlequin blueflag), *Lycopus americanus* (American water horehound), and *Solidago canadensis* (Canada goldenrod).

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This wet sedge meadow community was sampled once in the park. The site is on the seasonally flooded floodplain of the Crystal River. The soil is very poorly drained peat. The unvegetated surface is dominated by leaf litter (65% cover) and dead plant stems (35%). Evidence of disturbance includes river flooding and the presence of exotic plants.
Global Environment: Sites occur in stream valleys, along lake margins, and in depressions and channels in glacial outwash. Soils include wet mineral soils, muck, or shallow peat (<0.5 m), with the water table below the surface for most of the growing season (Chapman et al. 1989, MNNHP 1993).

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: This densely vegetated (100% cover) herbaceous community is strongly dominated by *Carex stricta* (upright sedge) with 90% cover. Additional graminoids include *Agrostis hyemalis* (winter bentgrass), *Carex aquatilis* (water sedge), and *Carex hystericina* (bottlebrush sedge). Forbs include *Asclepias incarnata* (swamp milkweed), *Boehmeria cylindrica* (small-spike false nettle), *Campanula aparinoides* (marsh bellflower), *Epilobium leptophyllum* (bog willowherb), *Eupatorium maculatum* (spotted joepyeweed), *Impatiens capensis* (jewelweed), *Lycopus uniflorus* (northern bugleweed), *Mentha arvensis* (wild mint), *Mimulus ringens* (Allegheny monkeyflower), *Pilea pumila* (Canadian clearweed), *Solidago canadensis* (Canada goldenrod), and *Triadenum fraseri* (Fraser's marsh St. Johnswort). Exotics present include *Cirsium vulgare* (bull thistle) and *Polygonum hydropiper* (marshpepper knotweed). In addition, there is a few scattered short shrubs of *Rosa palustris* (swamp rose).
Global Vegetation: The vegetation is dominated by sedges and grasses, but the shrub component can be high as 25%. Dominant plants include *Calamagrostis canadensis* (bluejoint) and *Carex stricta* (upright sedge). Associated graminoids include *Carex aquatilis* (water sedge), *Carex pellita* (woolly sedge), *Carex bebbii* (Bebb's sedge), *Carex lacustris* (hairy sedge), *Eleocharis* (spikerush) spp., *Juncus* (rush) spp., *Phalaris arundinacea* (reed canarygrass) (common in more degraded examples), and *Typha latifolia* (broadleaf cattail). Typical forbs include *Anemone canadensis* (Canadian anemone), *Asclepias incarnata* (swamp milkweed), *Symphyotrichum lanceolatum* var. *lanceolatum* (white panicle aster), *Equisetum arvense* (field horsetail), *Eupatorium maculatum* (spotted joepyeweed), *Eupatorium perfoliatum* (common boneset), *Iris versicolor* (harlequin blueflag), *Lycopus americanus* (American water horehound), and *Solidago canadensis* (Canada goldenrod) (Curtis 1959, Chapman et al. 1989, MNNHP 1993).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Carex stricta* (upright sedge)

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CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Carex stricta* (upright sedge)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Cirsium vulgare* (bull thistle, exotic, Medium/Low), *Polygonum hydropiper* (marshpepper knotweed, exotic)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4? (3-Oct-1996).

CLASSIFICATION

Classification Confidence: 2 - Moderate

Global Comments: This type may have some fen characteristics, but stands dominated by *Carex stricta* (upright sedge) with fen associates are better placed in *Carex stricta - Valeriana edulis - Parnassia palustris* Herbaceous Vegetation (CEGL005241), whose concept is strongly based on northeastern Iowa stands (Leoschke and Pearson 1987). The northern limits of this type are not clear with respect to *Carex (rostrata, utriculata) - Carex lacustris - (Carex vesicaria)* Herbaceous Vegetation (CEGL002257). Wet meadow stands in the northern parts of Michigan, Wisconsin, and Minnesota are usually placed in CEGL002257, and, although they are more typically dominated by coarse sedges (*Carex rostrata* (beaked sedge), *Carex lacustris* (hairy sedge), *Carex vesicaria* (blister sedge)), they can occasionally have dominance by *Carex stricta* (upright sedge)) (Harris et al. 1996, W12). As a result ecoregion distribution of this type needs review. Ontario stands may have some *Carex lasiocarpa* (woollyfruit sedge) in this type.

Global Similar Associations:

- *Calamagrostis canadensis - Eupatorium maculatum* Herbaceous Vegetation (CEGL005174)
- *Carex (rostrata, utriculata) - Carex lacustris - (Carex vesicaria)* Herbaceous Vegetation (CEGL002257)--This types is typically dominated by coarse sedges, but occasionally by *Carex stricta*.
- *Carex lacustris* Herbaceous Vegetation (CEGL002256)
- *Carex* spp. *- (Carex pellita, Carex vulpinoidea)* Herbaceous Vegetation (CEGL005272)
- *Carex stricta - Carex vesicaria* Herbaceous Vegetation (CEGL006412)
- *Carex stricta - Valeriana edulis - Parnassia palustris* Herbaceous Vegetation (CEGL005241)--This is the fen equivalent of the sedge meadow type.
- *Chamaedaphne calyculata / Carex oligosperma / Sphagnum* spp. Dwarf-shrubland (CEGL005091)
- *Cornus sericea - Salix (bebbiana, discolor, petiolaris) / Calamagrostis stricta* Shrubland (CEGL002187)

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Crystal River.

Global Range: This wet sedge meadow community is found in the southern Great Lakes region of the United States and Canada, and parts of the central Midwest, ranging from Indiana and Ontario, west to Minnesota and Iowa.

Nations: CA, US

States/Provinces: IA:S3, IL:S2, IN, MI:S3, MN, ND:S2S3, ON, QC, WI:S3

USFS Ecoregions (1994/95): 212Hb:CCC, 212Hl:CCC, 212Hm:CCP, 212Hn:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Ht:CCP, 212Hv:CCC, 212Hw:CCC, 212Hx:CCP, 212Hy:CCC, 212Ib:CPP, 212Ja:CCP, 212Jb:CC?, 212Jc:CCP, 212Je:CCP, 212Jf:CCC, 212Jj:CCP, 212Jk:CCC, 212Jl:CCP, 212Jm:CCC, 212Ka:CPP, 212Mb:CPP, 212Na:CPP, 212Nb:CPP, 212Nc:CPP, 212:Oa:CCC, 222Ha:CPP, 222Hb:CPP, 222Ja:CCP, 222Jb:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222Jj:CCC, 222Ka:CCC, 222Kb:CCC, 222Kd:CCC, 222Ke:CCC, 222Kf:CCC, 222Kg:CCC, 222Kh:CCC, 222Ki:CCC, 222Kj:CCC, 222Lb:CCC, 222Lc:CCC, 222Le:CCC, 222Lf:CCC, 222Me:CCC, 251Aa:CCC, 251Ab:CCC, 251Bb:CCC, 251Bd:CCC, 251Ca:CCC, 251Cc:CCC, 251Cf:CCC, 251Ch:CCC, 251Dc:CCC, 251Dd:CCP, 251Dg:CCC, 251Dh:CCP

Federal Lands: NPS (Indiana Dunes, Saint Croix, Sleeping Bear Dunes); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron, Huron-Manistee, Manistee, Nicolet)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.69.

Sleeping Bear Dunes National Lakeshore Map Code: HUS

Local Description Authors: M.J. Russo

Global Description Authors: D. Faber-Langendoen

References: Chapman et al. 1989, Curtis 1959, Harris et al. 1996, INAI unpubl. data, Leoschke and Pearson 1987, MNNHP 1993, Midwestern Ecology Working Group n.d., NDNHI unpubl. data, WNHIP unpubl. data, White and Madany 1978

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Dogwood - Willow Swamp

***Cornus sericea* - *Salix* spp. - (*Rosa palustris*) Shrubland**
Red-osier Dogwood - Willow species - (Swamp Rose) Shrubland
Identifier: CEGL002186

NVC CLASSIFICATION

Division	Eastern North America Freshwater Wet Meadow, Riparian & Marsh (2.C.5.Na)
Macrogroup	Eastern North American Wet Meadow & Marsh (M069)
Group	Eastern North American Wet Meadow Group (G112)
Association (Common name)	Dogwood - Willow Swamp
Ecological System(s):	Boreal Ice-Scour Rivershore (CES103.589)
Ecological System(s):	Eastern Great Plains Wet Meadow, Prairie and Marsh (CES205.687)
	Eastern Boreal Floodplain (CES103.588)
	North-Central Interior Wet Meadow-Shrub Swamp (CES202.701)
	Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582)

ELEMENT CONCEPT

Global Summary: This dogwood - willow shrub swamp community is found in the upper midwestern region of the United States and Canada. Stands are found along streams and lakes, or in upland depressions. Hydrology is variable but is typically seasonally flooded. Soils are wet, organic, and minerotrophic, with either highly decomposed peat or fine mineral soils. The vegetation is dominated by tall shrubs between 1 and 3 m tall, with at least 25% cover, and often very dense (>60% cover). More open stands may have high graminoid cover. Trees may be scattered but cover less than 25%. Composition of the shrub layer is quite diverse, primarily due to the diversity of *Salix* (willow) spp., which collectively share dominance with *Cornus sericea* (red-osier dogwood). Willow species include *Salix bebbiana* (Bebb willow), *Salix discolor* (pussy willow), *Salix eriocephala* (Missouri River willow), *Salix interior* (sandbar willow), *Salix fragilis* (crack willow), and *Salix petiolaris* (meadow willow). Other shrub associates include *Cephalanthus occidentalis* (common buttonbush) (southeastward), *Cornus amomum* (silky dogwood), *Ribes americanum* (American black currant), *Rosa palustris* (swamp rose) (more common eastward), *Rosa blanda* (smooth rose) and *Rosa woodsii* var. *woodsii* (Woods' rose) (more common westward), *Rubus pubescens* (dwarf red blackberry) (northward), *Rubus idaeus* ssp. *strigosus* (grayleaf red raspberry), *Sambucus canadensis* (common elderberry), *Spiraea alba* (white meadowsweet), and *Viburnum lentago* (nannyberry). Woody vines present include *Clematis virginiana* (devil's darning needles), *Parthenocissus quinquefolia* (Virginia creeper), and *Toxicodendron radicans* (eastern poison-ivy). Characteristic herbs include *Asclepias incarnata* (swamp milkweed), *Symphyotrichum lanceolatum* var. *lanceolatum* (white panicle aster), *Calamagrostis canadensis* (bluejoint), *Eupatorium maculatum* (spotted joepyeweed), *Glyceria striata* (fowl mannagrass), *Impatiens capensis* (jewelweed), *Lycopus americanus* (American water horehound), *Lycopus uniflorus* (northern bugleweed), *Phalaris arundinacea* (reed canarygrass), *Solidago gigantea* (giant goldenrod), and *Thalictrum dasycarpum* (purple meadowrue). A variety of sedges may dominate more open stands, including *Carex lacustris* (hairy sedge) and *Carex stricta* (upright sedge). Tree species include *Acer rubrum* (red maple), *Fraxinus pennsylvanica* (green ash), and *Ulmus americana* (American elm).

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This dogwood - willow shrub swamp community was sampled at three locations in the park. Sites are flat, seasonally flooded to saturated depressions and lakeplains bordering lakes. Soils are variable and include somewhat poorly drained loamy sand, poorly drained peat and moderately well-drained sand. The unvegetated surface is made up of leaf litter (5-95% cover), wood (0-40%), bare soil (0-15%) and dead plant stems (5-80%). No evidence of disturbance was reported.

Global Environment: Stands are found along streams and lakes, or in upland depressions. Hydrology is variable, but is typically seasonally flooded. Soils are wet, organic, and minerotrophic, with either highly decomposed peat or fine mineral soils (Curtis 1959, Harris et al. 1996).

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: The very sparse to very dense (5-90%) tall-shrub layer (2-5 m) and very sparse to very dense (<5-90%) short-shrub layer (0.5-2 m) is dominated by *Cornus amomum* (silky dogwood) and may include significant amounts of *Salix discolor* (pussy willow) (80% cover in one stand). Additional short shrubs include *Cornus rugosa* (roundleaf dogwood), *Cornus sericea* (red-osier dogwood), *Rosa palustris* (swamp rose), and *Salix myricoides* (bayberry willow). *Rubus pubescens* (dwarf red blackberry) forms a very sparse (<5%) dwarf-shrub layer. The herbaceous layer of one stand has 90% cover of Carex eburnea; the other sampled stand has a very sparse (5%) herb layer. Additional species may include *Arisaema triphyllum* (Jack in the pulpit), *Asclepias incarnata* (swamp milkweed), *Boehmeria cylindrica* (small-spike false nettle), *Calamagrostis canadensis* (bluejoint), *Carex bebbii* (Bebb's sedge), *Carex rostrata* (beaked sedge), *Cicuta bulbifera* (bulblet-bearing water hemlock), *Circaea alpina* (small enchanter's nightshade), *Dichanthelium acuminatum* var. *fasciculatum* (western panicgrass), *Dryopteris cristata* (crested woodfern), *Eupatorium perfoliatum* (common boneset), *Glyceria striata* (fowl mannagrass), *Iris virginica* (Virginia iris), *Lycopus americanus* (American water horehound), *Lycopus uniflorus* (northern bugleweed), *Mentha arvensis* (wild mint), *Phragmites australis* (common reed), *Polygonum amphibium* var. *stipulaceum* (water smartweed), *Pyrola americana* (American wintergreen), *Scutellaria lateriflora* (blue skullcap), *Solidago patula* (roundleaf goldenrod), *Symphyotrichum lateriflorum*

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(calico aster), *Symphyotrichum puniceum* (purplestem aster), *Thelypteris palustris* (eastern marsh fern) (up to 30% cover in one stand), and *Triadenum fraseri* (Fraser's marsh St. Johnswort).

Global Vegetation: The vegetation is dominated by tall shrubs between 1 and 3 m tall, with at least 25% cover, and often very dense (>60% cover). More open stands may have high graminoid cover. Trees may be scattered, but cover less than 25%. Composition of the shrub layer is quite diverse, primarily due to the diversity of *Salix* (willow) spp., which collectively share dominance with *Cornus sericea* (red-osier dogwood). Willow species include *Salix bebbiana* (Bebb willow), *Salix discolor* (pussy willow), *Salix eriocephala* (Missouri River willow), *Salix exigua* (narrowleaf willow), *Salix fragilis* (crack willow), and *Salix petiolaris* (meadow willow). Other shrubs associates include *Cephalanthus occidentalis* (common buttonbush) (southeastward), *Cornus amomum* (silky dogwood), *Ribes americanum* (American black currant), *Rosa palustris* (swamp rose) (more common eastward), *Rosa blanda* (smooth rose) and *Rosa woodsii* var. *woodsii* (Woods' rose) (more common westward), *Rubus pubescens* (dwarf red blackberry) (northward), *Rubus idaeus* ssp. *strigosus* (grayleaf red raspberry), *Sambucus canadensis* (common elderberry), *Spiraea alba* (white meadowsweet), and *Viburnum lentago* (nannyberry). Woody vines present include *Clematis virginiana* (devil's darning needles), *Parthenocissus quinquefolia* (Virginia creeper), and *Toxicodendron radicans* (eastern poison-ivy). Characteristic herbs include *Asclepias incarnata* (swamp milkweed), *Symphyotrichum lanceolatum* var. *lanceolatum* (white panicle aster), *Calamagrostis canadensis* (bluejoint), *Eupatorium maculatum* (spotted joepyeweed), *Glyceria striata* (fowl mannagrass), *Impatiens capensis* (jewelweed), *Lycopus americanus* (American water horehound), *Lycopus uniflorus* (northern bugleweed), *Phalaris arundinacea* (reed canarygrass), *Solidago gigantea* (giant goldenrod), and *Thalictrum dasycarpum* (purple meadowrue). A variety of sedges may dominate more open stands, including *Carex lacustris* (hairy sedge) and *Carex stricta* (upright sedge). Tree species include *Acer rubrum* (red maple), *Fraxinus pennsylvanica* (green ash), and *Ulmus americana* (American elm) (Curtis 1959, White and Madany 1978, Chapman et al. 1989, Reschke 1990, MNNHP 1993, Harris et al. 1996).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Cornus amomum* (silky dogwood)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Salix discolor* (pussy willow)
Herb (field)	Graminoid	*Carex eburnea* (bristleleaf sedge)
Herb (field)	Fern or fern ally	*Thelypteris palustris* (eastern marsh fern)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Carex eburnea* (bristleleaf sedge), *Cornus amomum* (silky dogwood), *Cornus sericea* ssp. *sericea* (red-osier dogwood), *Salix discolor* (pussy willow), *Thelypteris palustris* (eastern marsh fern)

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (3-Oct-1996).

CLASSIFICATION

Classification Confidence: 2 - Moderate

Global Comments: The closely related shrub meadow type is *Cornus sericea - Salix (bebbiana, discolor, petiolaris) / Calamagrostis stricta* Shrubland (CEGL002187), with which this type intergrades, and which generally has a more open shrub cover (25-50% cover). It's conceivable that the two types could be combined. It is also possible that a number of different *Salix* (willow) and *Cornus* (dogwood) shrub swamp types could be recognized with further study. A boreal/sub-boreal type may also be needed (e.g., Harris et al. 1996). Rich shrub fens, typically on a more peaty substrate or with calcareous indicators overlap to some degree with this type, but are a separate group (e.g., *Cornus amomum - Salix* spp. - *Toxicodendron vernix - Rhamnus lanceolata* Fen Shrubland (CEGL005087) and *Cornus sericea - Cornus amomum - Photinia melanocarpa - Viburnum lentago* Fen Shrubland (CEGL005088)). In Ontario, a coarsely defined type, Mixed Deciduous Thicket Swamp Shrubland (CEGL005086), covers a number of more locally dominant species recorded there, e.g., shrub swamps dominated by any of the following: *Acer spicatum* (mountain maple), *Lindera benzoin* (northern spicebush), *Viburnum dentatum* (southern arrow-wood), *Viburnum lentago* (nannyberry) (Bakowsky and Lee 1996, Lee et al. 1998). In New York, this type may occur on the Great Lakes plain.

Global Similar Associations:

- *Chamaedaphne calyculata - Myrica gale / Carex lasiocarpa* Dwarf-shrubland (CEGL005228)
- *Cornus (amomum, sericea) - Viburnum dentatum - Rosa multiflora* Shrubland (CEGL006576)
- *Cornus amomum - Salix* spp. - *Toxicodendron vernix - Rhamnus lanceolata* Fen Shrubland (CEGL005087)--is a tall shrub fen.
- *Cornus sericea - Cornus amomum - Photinia melanocarpa - Viburnum lentago* Fen Shrubland (CEGL005088)--is a tall shrub fen.
- *Cornus sericea - Salix (bebbiana, discolor, petiolaris) / Calamagrostis stricta* Shrubland (CEGL002187)--is somewhat drier, but grades into this type.
- Mixed Deciduous Thicket Swamp Shrubland (CEGL005086)--is a "collective" type, covering a number of different provincial types that contain dominant species that do not easily fit elsewhere.
- *Symplocarpus foetidus* Herbaceous Vegetation (CEGL002385)

Global Related Concepts:

- Shrub Carr (Curtis 1959) =
- Shrub Swamps (Anderson 1996) B
- Thicket swamp: tall willow (W36) (Harris et al. 1996) =

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ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled at Shell Lake and Round Lake.
Global Range: This dogwood - willow shrubland swamp is found in the upper midwestern region of the United States and adjacent Canada, ranging from Minnesota east to western New York and Ontario, south to Illinois and Indiana.
Nations: CA, US
States/Provinces: IL, IN, MI, MN:S4, NY, OH, ON, PA, QC, WI:S4
USFS Ecoregions (1994/95): 212Hb:CCP, 212He:CC?, 212Hh:CC?, 212Hi:CCC, 212Hj:CC?, 212Hl:CC?, 212Hm:CC?, 212Ho:CCC, 212Hr:CC?, 212Hs:CC?, 212Ht:CCP, 212Hu:CCP, 212Hv:CC?, 212Hw:CCC, 212Hx:CC?, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Je:CPP, 212Jf:CPP, 212Jj:CPP, 212Jl:CPP, 212Jm:CPP, 212Ka:CCP, 212Kb:CCC, 212La:CPP, 212Mb:CPP, 212Na:CCP, 212Nb:CCP, 212Nc:CCC, 212:Oa:CCC, 221Ea:CCC, 221Fa:CCC, 222Ib:CCC, 222Ic:CCP, 222Id:CCP, 222Ja:CC?, 222Je:CCC, 222Ji:CCC, 222Jj:CCC, 222Ke:CCC, 222Kf:CCC, 222Lc:CCC, 222Mb:CCC, 222Mc:CCC, 222Md:CCC, 222Me:CCC, 222Na:CCC, 251Ba:CCC, 251Cf:CCC
Federal Lands: NPS (Indiana Dunes, Pictured Rocks, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Hiawatha, Nicolet, Ottawa?, Superior?); USFWS (Erie, Iroquois)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.17, SLBE.60, SLBE.77.
Sleeping Bear Dunes National Lakeshore Map Code: SDW, SBC
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Anderson 1996, Bakowsky and Lee 1996, Borowitz and Stephenson 1985, Chapman et al. 1989, Curtis 1959, Edinger et al. 2002, Harris et al. 1996, Lee et al. 1998, MNNHP 1993, Midwestern Ecology Working Group n.d., Reschke 1990, WNHIP unpubl. data, White and Madany 1978

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5. Aquatic Vegetation

5.B.1. Freshwater Aquatic Vegetation

5.B.1.Na. North American Freshwater Aquatic Vegetation

M108. Eastern North American Freshwater Aquatic Vegetation

G114. Eastern North American Freshwater Aquatic Vegetation Group

Northern Water-lily Aquatic Wetland

***Nymphaea odorata - Nuphar (microphylla, variegata)* Herbaceous Vegetation**
American White Water-lily - (Yellow Pond-lily, Variegated Yellow Pond-lily) Herbaceous Vegetation
Identifier: CEGL002562

NVC CLASSIFICATION

Division	North American Freshwater Aquatic Vegetation (5.B.1.Na)
Macrogroup	Eastern North American Freshwater Aquatic Vegetation (M108)
Group	Eastern North American Freshwater Aquatic Vegetation Group (G114)
Association (Common name)	Northern Water-lily Aquatic Wetland
Ecological System(s):	Laurentian-Acadian Freshwater Marsh (CES201.594)

ELEMENT CONCEPT

Global Summary: This water-lily aquatic wetland type occurs throughout the upper midwestern region of the United States and adjacent Canada. Stands occur in open, slow-moving water on lakes and streams, often less than 0.5 m deep. The substrate is variable, from muck to sedimentary peat. Emergent vegetation cover is less than 25% and floating-leaved aquatics cover at least 25% of the surface. Typical dominants vary from stand to stand but include *Nymphaea odorata* (American white waterlily), *Nuphar microphylla* (yellow pond-lily), and *Nuphar variegata* (variegated yellow pond-lily). Other dominants may include *Brasenia schreberi* (watershield) and *Potamogeton amplifolius* (largeleaf pondweed). A variety of emergent species can occur in this community.

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This water-lily aquatic wetland community was sampled twice in the park. Sites are located along the edges of lakes with very poorly drained muck soil. The unvegetated surface is made up of dead plant stems (0-55% cover), wood (0-5%), bare soil (10%) and standing water (20-90%). Evidence of disturbance includes signs of beaver activity.

Global Environment: Stands occur in open, slow-moving water on lakes and streams, often less than 0.5 m deep. The substrate is variable, from muck to sedimentary peat (Harris et al. 1996)

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: This wetland community is dominated almost exclusively by a dense (80-90% cover) layer of floating aquatics *Nuphar lutea* ssp. *variegata* or *Nymphaea odorata* (American white waterlily). Additional species may include small amounts of *Carex aquatilis* (water sedge), *Decodon verticillatus* (swamp-loosestrife), *Schoenoplectus acutus* (hardstem bulrush), *Schoenoplectus tabernaemontani* (softstem bulrush), *Typha latifolia* (broadleaf cattail), and *Utricularia cornuta* (horned bladderwort).

Global Vegetation: Emergent vegetation cover is less than 25% and floating-leaved aquatics cover at least 25% of the surface. Typical dominants vary from stand to stand but include *Nymphaea odorata* (American white waterlily), *Nuphar microphylla* (yellow pond-lily), and *Nuphar variegata* (variegated yellow pond-lily). Other dominants may include *Brasenia schreberi* (watershield) and *Potamogeton amplifolius* (largeleaf pondweed). A variety of emergent species can occur within this type (Harris et al. 1996).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Floating aquatic	Aquatic herb (floating & submergent)	*Nuphar variegata* (variegated yellow pond-lily), *Nymphaea odorata* (American white waterlily)

Global

Stratum	Lifeform	Species
Floating aquatic	Aquatic herb (floating & submergent)	*Nuphar microphylla* (yellow pond-lily), *Nuphar variegata* (variegated yellow pond-lily), *Nymphaea odorata* (American white waterlily)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Nuphar variegata* (variegated yellow pond-lily), *Nymphaea odorata* (American white waterlily)

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Global: *Nuphar microphylla* (yellow pond-lily), *Nuphar variegata* (variegated yellow pond-lily), *Nymphaea odorata* (American white waterlily)

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (3-Oct-1996).

CLASSIFICATION

Classification Confidence: 3 - Weak
Global Comments: This type is not well-characterized across its range. Further review is needed in the United States. Depending on spatial scale, it conceptually overlaps both submergent and emergent aquatic types.
Global Related Concepts:

- Inland Emergent Marsh (Chapman et al. 1989) B
- Open water marsh: floating-leaved plants (W4) (Harris et al. 1996) =
- Pond-lily Formation (Pound and Clements 1900) ?
- Sandhills Aquatic Wetland (Steinauer and Rolfsmeier 2003) B
- Sandhills Open Water Marsh (Steinauer and Rolfsmeier 1997) B
- Sandhills Open Water Marsh (Steinauer and Rolfsmeier 2000) B
- Water lily Association (Pool 1914) ?

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled at Round Lake and on North Manitou Island (Tamarack Lake).
Global Range: This water-lily aquatic wetland type occurs throughout the upper midwestern region of the United States and adjacent Canada.
Nations: CA, US
States/Provinces: MB:S2, MI, MN, NE?:S2, NY, ON, QC:S5?, WI
USFS Ecoregions (1994/95): 212Hi:CCC, 212Hl:CCP, 212Hm:CCP, 212Hn:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hv:CCP, 212Hw:CCC, 212Hx:CCP, 212Hy:CCP, 212Ia:CCC, 212Ib:CCP, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Jl:CPP, 212Jn:CPP, 212Jo:CPP, 212La:CPP, 212Mb:CPP, 212Na:CPP, 212Nb:CPP, 212Nc:CPP, 212:Oa:CCC, 221B:CC, 222Jb:CCC, 222Je:CCC, M212:C
Federal Lands: NPS (Apostle Islands, Grand Portage, Isle Royale, Pictured Rocks, Sleeping Bear Dunes, Voyageurs); USFS (Chippewa, Huron, Huron-Manistee, Manistee?, Ottawa, Superior?)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.58, SLBE.113.
Sleeping Bear Dunes National Lakeshore Map Code: HFA
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Chapman et al. 1989, Edinger et al. 2002, Greenall 1996, Harris et al. 1996, Midwestern Ecology Working Group n.d., Pool 1914, Pound and Clements 1900, Steinauer and Rolfsmeier 1997, Steinauer and Rolfsmeier 2000, Steinauer and Rolfsmeier 2003, WNHIP unpubl. data

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Midwest Pondweed Submerged Aquatic Wetland

***Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation**
Pondweed species - Hornwort species Midwest Herbaceous Vegetation
Identifier: CEGL002282

NVC CLASSIFICATION

Division	North American Freshwater Aquatic Vegetation (5.B.1.Na)
Macrogroup	Eastern North American Freshwater Aquatic Vegetation (M108)
Group	Eastern North American Freshwater Aquatic Vegetation Group (G114)
Association (Common name)	Midwest Pondweed Submerged Aquatic Wetland
Ecological System(s):	Eastern Great Plains Wet Meadow, Prairie and Marsh (CES205.687)
	North-Central Interior Floodplain (CES202.694)
Ecological System(s):	Laurentian-Acadian Freshwater Marsh (CES201.594)
	North-Central Interior Freshwater Marsh (CES202.899)

ELEMENT CONCEPT

Global Summary: This broadly defined submerged aquatic or open marsh type is found throughout the midwestern region of the United States and adjacent Canada. Based on information in the northern parts of the Midwest, several vegetation subgroups can be recognized that may be separate associations. Subgroup A is a shallow (<50 cm), sparsely vegetated, open water marsh found on sand, or organic and mineral material trapped in rocky bottoms. Stands are often exposed to wave action and found in oligotrophic lakes. Dominant plants often have basal rosettes that are resistant to wave action. Typical species include *Elatine minima* (small waterwort), *Eriocaulon aquaticum* (sevenangle pipewort), *Gratiola aurea* (golden hedgehyssop), *Isoetes tenella* (spiny-spore quillwort), *Isoetes lacustris* (lake quillwort), *Juncus pelocarpus* (brownfruit rush), and *Lobelia dortmanna* (Dortmann's cardinalflower). Subgroup B is a shallow (<50 cm) open water marsh with emergent cover <25% and floating-leaved aquatics >25%. Substrate is a mineral soil (often sand), boulders, or a mixture of sedimentary peat and fine mineral soil. Stands can be exposed to waves or are in stream channels. Stands may often be dominated by a single species. Typical dominants include *Eleocharis acicularis* (needle spikerush), *Myriophyllum* (watermilfoil) spp., *Potamogeton amplifolius* (largeleaf pondweed), *Potamogeton gramineus* (variableleaf pondweed), *Potamogeton praelongus* (whitestem pondweed), *Potamogeton robbinsii* (Robbins' pondweed), *Sparganium fluctuans* (floating bur-reed), and *Utricularia macrorhiza* (common bladderwort). Subgroup C includes open water marsh with emergent cover <25% and floating leaved aquatics >25%. Substrate is sedimentary peat and stands are often found in sheltered bays of lakes and streams that do not have high wave energy. Stands may often be dominated by a single species. Typical dominants include *Ceratophyllum demersum* (coon's-tail), *Elodea canadensis* (Canadian waterweed), *Lemna* (duckweed) spp., *Myriophyllum sibiricum* (shortspike watermilfoil), *Myriophyllum verticillatum* (whorl-leaf watermilfoil), *Potamogeton natans* (floating pondweed), *Stuckenia pectinata* (sago pondweed), *Potamogeton richardsonii* (Richardson's pondweed), *Potamogeton zosteriformis* (flatstem pondweed), *Ranunculus aquatilis* (whitewater crowfoot), *Utricularia macrorhiza* (common bladderwort), and *Vallisneria americana* (American eel-grass).

ENVIRONMENTAL DESCRIPTION

Sleeping Bear Dunes National Lakeshore Environment: This submerged aquatic marsh type was sampled at two locations in the park. One site is the permanently flooded streambed of the Crystal River, the other is along a saturated, gently sloping, east-facing shoreline of a lake. Soil is sand. The unvegetated surface is dominated by bare sand (53-90% cover) with some leaf litter (0-2%), wood (0-10%), dead plant stems (0-20%) and standing water (0-20%). No evidence of disturbance was reported, other than the presence of exotic plants, despite the abundant use of Crystal River by kayakers.

Global Environment: Curtis (1959) [see also Swindale and Curtis (1957)] noted that the major environmental controls on submerged aquatic vegetation are water depth (as it relates to light intensity), water chemistry, water movement, and nature of the substrate. Various combinations of these factors can interact in a variety of ways to influence the local composition of the community. As a result, a single lake may contain a number of relatively homogeneous stands, each with a different species makeup, which depends on depth, nature of adjoining shoreline, degree of protection from waves, etc. Water chemistry may be one of the few constants. Assessment of water conductivity and alkalinity are two measured parameters that can provide some understanding of the influence of water chemistry on species composition.

VEGETATION DESCRIPTION

Sleeping Bear Dunes National Lakeshore Vegetation: This community is dominated by a moderately vegetated layer (40-50% cover) of floating and submerged aquatic species, including *Ceratophyllum demersum* (coon's-tail), *Myriophyllum tenellum* (slender watermilfoil), *Najas flexilis* (nodding waternymph), *Potamogeton crispus* (curly pondweed) (exotic), *Potamogeton illinoensis* (Illinois pondweed), *Potamogeton richardsonii* (Richardson's pondweed), and *Stuckenia pectinata* (sago pondweed). Additional herbs include *Juncus pelocarpus* (brownfruit rush) and *Schoenoplectus acutus* (hardstem bulrush). *Chara* spp. (macrophytic algae) may have up to 30% cover.

Global Vegetation: Based on information in the northern parts of the Midwest, several vegetation subgroups can be recognized that may be separate associations. Subgroup A is a shallow (<50 cm), sparsely vegetated, open-water marsh found on sand, or organic and mineral material trapped in rocky bottoms. Stands are often exposed to wave action and found in oligotrophic lakes. Dominant plants often have basal rosettes that are resistant to wave action. Typical species include *Elatine minima* (small waterwort), *Eriocaulon aquaticum* (sevenangle pipewort), *Gratiola aurea* (golden hedgehyssop), *Isoetes tenella* (spiny-spore quillwort), *Isoetes lacustris* (lake

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quillwort), *Juncus pelocarpus* (brownfruit rush), and *Lobelia dortmanna* (Dortmann's cardinalflower) (Curtis 1959, Harris et al. 1996). Subgroup B is a shallow (<50 cm), open-water marsh with emergent cover <25% and floating-leaved aquatics >25%. Substrate is a mineral soil (often sand), boulders, or a mixture of sedimentary peat and fine mineral soil. Stands can be exposed to waves or are in stream channels. Stands may often be dominated by a single species. Typical dominants include *Eleocharis acicularis* (needle spikerush), *Myriophyllum* (watermilfoil) spp., *Potamogeton amplifolius* (largeleaf pondweed), *Potamogeton gramineus* (variableleaf pondweed), *Potamogeton praelongus* (whitestem pondweed), *Potamogeton robbinsii* (Robbins' pondweed), *Sparganium fluctuans* (floating bur-reed), and *Utricularia macrorhiza* (common bladderwort). Subgroup C includes open-water marsh with emergent cover <25% and floating-leaved aquatics >25%. Substrate is sedimentary peat, and stands are often found in sheltered bays of lakes and streams that do not have high wave energy. Stands may often be dominated by a single species. Typical dominants include *Ceratophyllum demersum* (coon's-tail), *Elodea canadensis* (Canadian waterweed), *Lemna* (duckweed) spp., *Myriophyllum sibiricum* (shortspike watermilfoil), *Myriophyllum verticillatum* (whorl-leaf watermilfoil), *Potamogeton natans* (floating pondweed), *Stuckenia pectinata* (sago pondweed), *Potamogeton richardsonii* (Richardson's pondweed), *Potamogeton zosteriformis* (flatstem pondweed), *Ranunculus aquatilis* (whitewater crowfoot), *Utricularia macrorhiza* (common bladderwort), and *Vallisneria americana* (American eel-grass) (Curtis 1959, Harris et al. 1996).

MOST ABUNDANT SPECIES

Sleeping Bear Dunes National Lakeshore

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Juncus pelocarpus* (brownfruit rush)
Submerged aquatic	Aquatic herb (floating & submergent)	*Ceratophyllum demersum* (coon's-tail), *Myriophyllum tenellum* (slender watermilfoil)

CHARACTERISTIC SPECIES

Sleeping Bear Dunes National Lakeshore: *Ceratophyllum demersum* (coon's-tail), *Juncus pelocarpus* (brownfruit rush), *Myriophyllum tenellum* (slender watermilfoil), *Potamogeton illinoensis* (Illinois pondweed), *Potamogeton richardsonii* (Richardson's pondweed), *Stuckenia pectinata* (sago pondweed)

OTHER NOTEWORTHY SPECIES

Sleeping Bear Dunes National Lakeshore: Exotic/Invasive: *Potamogeton crispus* (curly pondweed, exotic, Medium)

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (3-Oct-1996).

CLASSIFICATION

Classification Confidence: 3 - Weak

Global Comments: This type is based on information in the more northern parts of the range. However, it may need to be split into a boreal/sub-boreal type (subgroup A above) and a Midwestern type (subgroups B and C), and even within the Midwest there may be substantial differences between western and eastern stands (Robert Dana pers. comm. 1999). In Wisconsin, Subgroup A is considered distinctive, and could be ranked an S3 type. It is locally common there in deep, hard-bottomed seepage lakes of the Northern Highlands Pitted Outwash subsection (212Jm of Keys et al. 1995) (E. Epstein pers. comm. 1999).

Global Similar Associations:

- *Stuckenia pectinata - Ruppia maritima* Herbaceous Vegetation (CEGL002004)--Prairie pothole type.

Global Related Concepts:

- Open water marsh: floating-leaved plants (W4) (Harris et al. 1996) I

ELEMENT DISTRIBUTION

Sleeping Bear Dunes National Lakeshore Range: This community was sampled along Crystal River and on South Manitou Island (Florence Lake).

Global Range: This pondweed submerged aquatic type is found widely throughout the midwestern United States and adjacent Canada, ranging from Ohio and Ontario west to North Dakota and south to Iowa.

Nations: CA, US

States/Provinces: IA:SU, IL, IN, MI:S4, MN, ND, OH, ON, SD, WI, WY

USFS Ecoregions (1994/95): 212Hb:CCP, 212Hi:CCC, 212Ho:CCC, 212Hs:CCC, 212Hv:CCC, 212Hw:CCC, 212Ia:CCC, 212Ib:CCP, 212Ja:CCP, 212Jb:CCP, 212Jc:CCP, 212Je:CCP, 212Jf:CCP, 212Jj:CCP, 212Jl:CCP, 212Jm:CCC, 212Ka:CPP, 212La:CPP, 212Mb:C?? , 212:Oa:CCC, 221Ef:CCC, 221Fc:CCC, 221He:CCC, 222Ao:CPP, 222Ch:CPP, 222Gc:CPP, 222Ha:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222Jj:CCC, 222Kf:CCC, 222L:CC, 251Aa:???, 251Ba:???

Federal Lands: NPS (Apostle Islands, Effigy Mounds, Grand Portage, Indiana Dunes, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Nicolet, Shawnee, Superior?)

ELEMENT SOURCES

Sleeping Bear Dunes National Lakeshore Plots: SLBE.70, SLBE.87.

Sleeping Bear Dunes National Lakeshore Map Code: HSV

Local Description Authors: M.J. Russo

Global Description Authors: D. Faber-Langendoen

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References: Chapman et al. 1989, Curtis 1959, Harris et al. 1996, Hop et al. 2005, INAI unpubl. data, Keys et al. 1995, Midwestern Ecology Working Group n.d., NDNHI unpubl. data, Swindale and Curtis 1957

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Appendix C: Field Key to Vegetation Types

Explanation and Use of the Key

This is a field key to natural vegetation types of Sleeping Bear Dunes National Lakeshore (SLBE). The vegetation types are based on the National Vegetation Classification Standard (NVCS), Version 2 (FGDC 2008) and were derived from field data collected during the SLBE vegetation mapping project. This key depicts vegetation types at the association (plant community) level, the lowest level of the NVCS, unless otherwise specified. For association types, the association name is given, followed by the Community Global Element (CEGL) code. For alliance types, the alliance name is given, followed by the Alliance Key (A.) code.

For best results, all assessments of vegetation types in the field should be done on an area of 5,000 m^2 (i.e., a 40-m radius around a point or a rectangle of 50 by 100 m) and within a single vegetation type. Appendix B: Descriptions of Vegetation Types is recommended to complement this key to ascertain correct assessment of types.

The term dominance means greater than 50% relative cover within a given stratum unless otherwise noted. When the term "total canopy cover" is used, it is in reference to the absolute canopy cover. All other cover values refer to relative canopy cover; e.g., if total cover of the tree canopy is 40%, then a notation of >25% cover of jack pine refers to 25% of the 40% total cover.

GENERAL KEY

1A. Absence of standing water and/or peat soil. Mineral soil not saturated throughout the growing season. Upland soils and vegetation prevalent. Wetlands absent or limited to occasional vernal pools. **2**

1B. Wetland soils and vegetation prevalent. Presence of standing water or saturated mineral, muck, or organic soils. **28**

UPLANDS

2A. Total tree canopy >25%. Forest or woodland. **3**

2B. Total tree canopy <25%. Dominated by shrubs or herbaceous vegetation or sparsely vegetated. **22**

3A. Total tree canopy cover <60%. Dominated by cottonwood (*Populus deltoides*), paper birch (*Betula papyrifera*), jack pine (*Pinus banksiana*), or red pine (*Pinus resinosa*) on excessively drained sand dunes. **4**

3B. Total tree canopy cover >60%. **6**

4A. Sparse, open canopy dominated by jack pine (*Pinus banksiana*) and/or red pine (*P. resinosa*). ..... ***Pinus banksiana* - (*Pinus resinosa*) - *Pinus strobus* / *Juniperus horizontalis* Wooded Herbaceous Vegetation [CEGL005125]** (See also Upland Herbaceous and Sparse Vegetation).

4B. Open tree canopy dominated by deciduous trees. **5**

5A. Tree canopy dominated by paper birch (*Betula papyrifera*) or sometimes balsam poplar (*Populus balsamifera*), sometimes with white cedar (*Thuja occidentalis*), white ash (*Fraxinus americana*), and maples (*Acer* spp.) present to co-dominant. ..... ***Populus deltoides* Woodland Alliance [A.1493]**

5B. Open tree canopy of scattered cottonwood (*Populus deltoides*). ..... ***Populus deltoides* - (*Juniperus virginiana*) Dune Woodland [CEGL005119]**

6A. Tree canopy >75% deciduous hardwood species. **7**
6B. Tree canopy <75% deciduous hardwood species. **10**

7A. Tree canopy dominated by sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), and/or white ash (*Fraxinus americana*). **8**
7B. Tree canopy dominated by red oak (*Quercus rubra*), aspen (*Populus tremuloides*), bigtooth aspen (*P. grandidentata*), and/or paper birch (*Betula papyrifera*). **9**

8A. Tree canopy >20% American beech (*Fagus grandifolia*) OR <20% white ash (*Fraxinus americana*) and basswood (*Tilia americana*). .....
***Acer saccharum* - *Fagus grandifolia* - *Betula* spp. / *Maianthemum canadense* Forest [CEGL005004]**
8B. Tree canopy >20% white ash (*Fraxinus americana*), and/or basswood (*Tilia americana*). Near Lake Michigan and sometimes the result of disturbance. .....
***Acer saccharum* - Fraxinus americana - Tilia americana / Acer spicatum / *Caulophyllum thalictroides* Forest [CEGL005008]**

9A. Tree canopy >40% red oak (*Quercus rubra*) along with other deciduous hardwood species. .....
***Quercus rubra* - *Acer saccharum* Forest [CEGL002461]**
9B. Tree canopy >75% bigtooth aspen (*Populus grandidentata*), aspen (*Populus* spp.), paper birch (*Betula papyrifera*), and/or red maple (*Acer rubrum*). .....
***Populus tremuloides* - *Betula papyrifera* - (*Acer rubrum*, *Populus grandidentata*) Forest [CEGL002467]**

10A. Tree canopy >75% conifers. **11**
10B. Tree canopy a mixture of conifers and deciduous species with >25% cover of each. **16**

11A. Tree canopy dominated by northern white-cedar (*Thuja occidentalis*) or eastern hemlock (*Tsuga canadensis*). **12**
11B. Tree canopy dominated by pines (*Pinus* spp.). **13**

12A. Tree canopy dominated by northern white-cedar (*Thuja occidentalis*) .....
***Thuja occidentalis* / *Abies balsamea* - *Acer spicatum* Forest [CEGL002449]**
12B. Tree canopy heavily dominated by eastern hemlock (*Tsuga canadensis*) and lacking major sugar maple (*Acer saccharum*) and American beech (*Fagus grandifolia*) component. .....
***Tsuga canadensis* - (*Betula alleghaniensis*) Forest [CEGL002598]**

13A. Tree canopy co-dominated by a mixture of pine species (*Pinus* spp.) AND shrub layer has >25% total canopy cover of shrubs such as bearberry (*Arctostaphylos uva-ursi*), creeping juniper (*Juniperus horizontalis*), and common juniper (*J. communis*). Occurs on dunes. .....
***Pinus banksiana* - *Pinus resinosa* - *Pinus strobus* Dune Forest [CEGL002589]**
13B. Tree canopy dominated by a single pine species OR a mix of pine species (*Pinus* spp.) with <25% total canopy cover of shrubs such as bearberry (*Arctostaphylos uva-ursi*), creeping juniper (*Juniperus horizontalis*), and common juniper (*J. communis*). Tree canopy may also include balsam fir (*Abies balsamea*) and/or eastern hemlock (*Tsuga canadensis*). **14**

14A. Tree canopy >25% white pine (*Pinus strobus*); *Vaccinium* spp. commonly in understory; not on open dunes .....
***Pinus strobus* / *Vaccinium* spp. Forest [CEGL002444]**
14B. Tree canopy <25% white pine (*Pinus strobus*) **15**

15A. Tree canopy >75% red pine (*Pinus resinosa*)..... ***Pinus resinosa* / *Vaccinium* spp. Forest [CEGL002443]**

15B. Tree canopy dominated by jack pine (*Pinus banksiana*). ..... ***Pinus banksiana* / *Vaccinium* spp. / *Pleurozium schreberi* Forest [CEGL002441]**

16A. Tree canopy >50% red pine (*Pinus resinosa*), white pine (*P. strobus*), jack pine (*P. banksiana*), northern red oak (*Quercus rubra*), aspen (*Populus* spp.), and/or paper birch (*Betula papyrifera*).**17**

16B. Conifer component of tree canopy dominated by northern white cedar (*Thuja occidentalis*), eastern hemlock (*Tsuga canadensis*), and/or balsam fir (*Abies balsamea*). **20**

17A. Tree canopy dominated by a combination of pine species (*Pinus* spp.) and oak species (*Quercus* spp.)..... **18**

17B. Tree canopy dominated by a combination of pine species (*Pinus* spp.) and aspen (*Populus* spp.), paper birch (*Betula papyrifera*), and/or red maple (*Acer rubrum*) **19**

18A. Among all tree canopy pines, white pine (*Pinus strobus*) >25% cover OR red pine (*P. resinosa*) >75% AND within the deciduous component, northern red oak (*Quercus rubra*) and/or white oak (*Q. alba*) >50% cover. ..... ***Pinus strobus* - (*Pinus resinosa*) - *Quercus rubra* Forest [CEGL002480]**

18B. Among all tree canopy pines, white pine (*Pinus strobus*) <25% cover AND red pine (*P. resinosa*) <75%; dominant deciduous trees are northern red oak (*Quercus rubra*) and rarely white oak (*Q. alba*)..... ***Pinus banksiana* - (*Pinus resinosa*) - *Quercus ellipsoidalis* / *Carex pensylvanica* Forest [CEGL002478]**

19A. Among the pines, red pine (*Pinus resinosa*) >75% cover. Deciduous component is dominated by a mix of aspen (*Populus* spp.), paper birch (*Betula papyrifera*), northern red oak (*Quercus rubra*), red maple (*Acer rubrum*). Note: if northern red oak (*Quercus rubra*) is >50% of the deciduous component, consider Couplet 17A (CEGL002480)..... ***Pinus resinosa* - *Populus tremuloides* / *Diervilla lonicera* - *Vaccinium* spp. Forest [CEGL002520]**

19B. Among the pines, white pine (*Pinus strobus*) >25% cover. Deciduous component is dominated by a mix of aspen (*Populus* spp.), paper birch (*Betula papyrifera*), northern red oak (*Quercus rubra*), and/or red maple (*Acer rubrum*). Note: if northern red oak (*Quercus rubra*) is >50% of the deciduous component, consider Couplet 17A (CEGL002480)..... ***Pinus strobus* - *Populus tremuloides* / *Corylus cornuta* Forest [CEGL002479]**

20A. Only on Manitou Islands, balsam fir (*Abies balsamea*) >75% of conifer component; deciduous component dominated by paper birch (*Betula papyrifera*) and quaking aspen (*Populus tremuloides*). ..... ***Picea glauca* - *Abies balsamea* - *Populus tremuloides* / Mixed Herbs Forest [CEGL002475]**

20B. Not as above..... **21**

21A. Tree canopy dominated by northern white-cedar (*Thuja occidentalis*), yellow birch (*Betula alleghaniensis*), and/or red maple (*Acer rubrum*)..... ***Thuja occidentalis* / *Abies balsamea* - *Acer spicatum* Forest [CEGL002449]**

21B. Tree canopy co-dominated by eastern hemlock (*Tsuga canadensis*) and American beech (*Fagus grandifolia*)/ sugar maple (*Acer saccharum*), with other hardwood species present..... ***Tsuga canadensis* - *Fagus grandifolia* - (*Acer saccharum*) Great Lakes Forest [CEGL005042]**

UPLAND SHRUBLANDS

22A. >25% total canopy cover by tall, short, or dwarf-shrubs. **23**
22B. <25% total canopy cover by tall, short, or dwarf-shrubs. **24**

23A. Typically, most abundant species are creeping or matted dwarf shrubs (typically <50 cm tall) such as creeping juniper (*Juniperus horizontalis*), bearberry (*Arctostaphylos uva-ursi*), but some sites may be dominated by taller common juniper (*Juniperus communis*). Occurs on dunes ..... . ***Juniperus horizontalis* - *Arctostaphylos uva-ursi* - *Juniperus communis* Dune Dwarf-shrubland [CEGL005064]**
23B. Most abundant species are tall or short shrubs (typically >50 cm tall). Shrubland dominated by sand cherry (*Prunus pumila*) and/or willows (*Salix* spp.). Occurs on dunes. (Compare with CEGL005064 & CEGL005098) ..... ***Prunus pumila* - (*Ptelea trifoliata*) Dune Shrubland [CEGL005075]**

UPLAND HERBACEOUS AND SPARSE VEGETATION

24A. Dominated by herbaceous vegetation on sand, but may have scattered trees. **25**
24B. Sparsely vegetated (<1% total vegetation canopy cover). **27**

25A. Jack pine (*Pinus banksiana*) 10-25% total canopy cover; on open sand. ..... ***Pinus banksiana* - (*Pinus resinosa*) - *Pinus strobus* / *Juniperus horizontalis* Wooded Herbaceous Vegetation [CEGL005125]** (See also couplet 5A).
25B. No scattered trees; herbaceous vegetation, often with shrub layer. **26**

26A. Vegetation dominated by marram grass (*Ammophila breviligulata*) and little bluestem (*Schizachyrium scoparium*). Occurs on dunes. ..... ***Ammophila breviligulata* - (*Schizachyrium scoparium*) Herbaceous Vegetation [CEGL005098]**
26B. Vegetation dominated by bracken fern (*Pteridium aquilinum*) with occasional sedges and grasses. Occurs on level plains or rolling uplands and in depressions in pitted outwash..... ***Pteridium aquilinum* - *Bromus kalmii* Herbaceous Vegetation [CEGL005142]**

27A. Sea rocket (*Cakile edentula*) growing along open sand beach of Great Lakes..... ***Cakile edentula* Great Lakes Shore Sparse Vegetation [CEGL005162]**
27B. Shrubs and herbs such as buttonbush (*Cephalanthus occidentalis*), swamp milkweed (*Asclepias incarnata*), wild blue flag (*Iris versicolor*), and twig-rush (*Cladium mariscoides*) occur along shores of inland freshwater lakes such as Bass Lake..... **Inland Freshwater Strand Beach Sparse Vegetation [CEGL002310]**

WETLANDS

28A. Total tree canopy >25%. Forest or woodland. **29**
28B. Total tree canopy <25%. Dominated by shrubs or herbaceous vegetation or sparsely vegetated. **37**

29A. Tree canopy >75% conifers (including *Larix laricina*) **30**
29B. Tree canopy <75% conifers (including *Larix laricina*). **33**

30A. Tree canopy dominated by black spruce (*Picea mariana*) and/or tamarack (*Larix laricina*). **31**
30B. Tree canopy dominated by white cedar (*Thuja occidentalis*) and/or balsam fir (*Abies balsamea*) ...
***Thuja occidentalis* - (*Picea mariana, Abies balsamea*) / *Alnus incana* Forest [CEGL002456]**

31A. Black spruce (*Picea mariana*) and/or tamarack (*Larix laricina*) growing on peat over ericaceous dwarf-shrubs. Short and tall shrubs <25% total canopy cover. .....
***Picea mariana* - (*Larix laricina*) / *Ledum groenlandicum* / Sphagnum spp. Forest [CEGL005271]**
31B. Tamarack (*Larix laricina*) growing over tall and short shrubs. Short and tall shrubs >25% total canopy cover. Peat may or may not be present. **32**

32A. Speckled alder (*Alnus incana*) and sometimes red-osier dogwood (*Cornus sericea*) are dominant shrubs. ..... ***Larix laricina* / *Alnus incana* Forest [CEGL002471]**
32B. Black chokeberry (*Photinia melanocarpa*) and sometimes common winterberry (*Ilex verticillata*) are dominant shrubs. .....
***Larix laricina* / *Photinia melanocarpa* / *Sphagnum* spp. Forest [CEGL002472]**

33A. Tree canopy >75% deciduous trees with understory conifers possible. **34**
33B. Tree canopy <75% deciduous trees. **35**

34A Tree canopy >50% black ash (*Fraxinus nigra*). .....
***Fraxinus nigra* - Mixed Hardwoods - Conifers / *Cornus sericea* / *Carex* spp. Forest [CEGL002105]**
34B. Tree canopy <50% black ash (*Fraxinus nigra*); dominated by a combination of black ash (*F. nigra*), red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*), paper birch (*B. papyrifera*), and tamarack (*Larix laricina*) .....
***Acer rubrum* - *Fraxinus* spp. - *Betula papyrifera* / *Cornus candensis* Forest [CEGL002071]**

35A. Tree canopy dominated by a mix of white pine (*Pinus strobus*) and red maple (*Acer rubrum*). Yellow birch (*Betula alleghaniensis*) and paper birch (*Betula papyrifera*) are common; tamarack (*Larix laricina*) and black ash (*Fraxinus nigra*) are rare to absent. .....
***Pinus strobus* - (*Acer rubrum*) / *Osmunda* spp. Forest [CEGl002482]**
35B. Tree canopy dominated by northern white cedar (*Thuja occidentalis*) or eastern hemlock (*Tsuga canadensis*) and deciduous hardwoods. **36**

36A. Tree canopy dominated by eastern hemlock (*Tsuga canadensis*) and yellow birch (*Betula alleghaniensis*). .....
***Tsuga canadensis* - *Betula alleghaniensis* Saturated Forest [CEGL005003]**
36B. Tree canopy dominated by northern white cedar (*Thuja occidentalis*) and black ash (*Fraxinus nigra*). Saturated soils are mineral or well-decomposed peat. .....
***Thuja occidentalis* - *Fraxinus nigra* Forest [CEGL005165]**

WETLAND SHRUBLANDS

37A. >25% total canopy cover by tall, short, or dwarf-shrubs. **38**
37B. <25% total canopy cover by tall, short, or dwarf-shrubs. **42**

38A. Dominated by tall shrubs such as speckled alder (*Alnus incana*), dogwood (*Cornus* spp.), willows (*Salix* spp.), and/or bog birch (*Betula pumila*). Occurs along streams, lakes, or depressions. **39**
38B. Dominated by short shrubs such as leatherleaf (*Chamaedaphne calyculata*), sweet gale (*Myrica gale*), or shrubby cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*). **40**

39A. Shrubland dominated by speckled alder (*Alnus incana*).....
***Alnus incana* Swamp Shrubland [CEGL002381]**
39B. Shrubland dominated by dogwood (*Cornus* spp.) and/or willows (*Salix* spp.).....
***Cornus sericea* - *Salix* spp. - (*Rosa palustris*) Shrubland [CEGL002186]**

40A. Short shrubs growing on marly, calcareous mud. .....
***Dasiphora fruticosa* ssp. *floribunda* - *Myrica gale* Rich Shore Fen Shrubland [CEGL005275]**
40B. Short shrubs growing on acid peat. Leatherleaf (*Chamaedaphne calyculata*) dominates, with or without scattered canopy of tamarack (*Larix laricina*) and/or black spruce (*Picea mariana*). **41**

41A. Sites on shorelines (shorefens), dense leatherleaf (*Chamaedaphne calyculata*) and/or sweetgale (*Myrica gale*) often with *Carex lasiocarpa*. .....
***Chamaedaphne calyculata* - *Myrica gale* / *Carex lasiocarpa* Dwarf-shrubland [CEGL005228]**
41B. High cover of leatherleaf (*Chamaedaphne calyculata*) sometimes with sweetgale (*Myrica gale*) growing with Sphagnum mosses. Not on shorelines. .....
***Chamaedaphne calyculata* / *Carex oligosperma* / *Sphagnum* spp. Poor Fen Dwarf-shrubland [CEGL005277]**

WETLAND HERBACEOUS VEGETATION

42A. Seasonally flooded, semipermanently flooded, or saturated herbaceous wetland. **43**
42B. Permanently or semipermanently flooded wetland with standing water generally >1 m deep..... **52**

43A. Wetland dominated by tall emergents, including bluejoint grass (*Calamagrostis canadensis*), reed canary grass (*Phalaris arundinacea*), cattails (*Typha* spp.), and tall reed (*Phragmites australis*). Occurs in seasonally flooded depressions, floodplains, or protected Great Lakes coastal wetlands.**44**
43B. Wetland primarily dominated by low emergent plants, including sedges (*Carex* spp.), twig-rush (*Cladium mariscoides*), three-way sedge (*Dulichium arundinaceum*), beak-rush (*Rhynchospora* spp.), spikerushes (*Eleocharis* spp.), and horsetails (*Equisetum fluviatile*). Grasses not dominant.**47**
43C. No strong dominants; sites on edges of wetland and show signs of disturbance (beavers, human-caused); sedges (*Carex* spp.), grasses, ferns, shrubs and small trees may all be present.....
Wet Meadow Mixed Herbaceous Map Class [HWM]

44A. Dominated by cat-tails (*Typha* spp.) and/or bulrushes (*Schoenoplectus acutus, S. tabernaemontani*). Occurs in basin depressions, river and pond margins, and on lakeplains..... **45**
44B. Dominated by grasses. **46**

45A. Cat-tails (*Typha* spp.) >80% cover with or without bulrushes (*Schoenoplectus* spp.).....
Typha spp. - Schoenoplectus acutus - Mixed Herbs Midwest Herbaceous Vegetation [CEGL002229]

45B. Cat-tails (*Typha* spp.) <80% cover, often dominated by bulrushes (*Schoenoplectus* spp.) and other tall emergents. .....
***Schoenoplectus acutus* - *Schoenoplectus subterminalis* - *Eleocharis palustris* - (*Schoenoplectus pungens*) Northern Great Lakes Shore Herbaceous Vegetation [CEGL005274]**

46A. Dominated by bluejoint grass (*Calamagrostis canadensis*) and reed canary grass (*Phalaris arundinacea*). .....
***Calamagrostis canadensis* - *Phalaris arundinacea* Herbaceous Vegetation [CEGL005174]**
46B. Strongly dominated (>80%) by *Phragmites australis*. .....
***Phragmites australis* Eastern North America Temperate Semi-natural Herbaceous Vegetation [CEGL004141]**

47A. Wetland not dominated by sedges (*Carex* spp.). Abundant species typically include twig-rush (*Cladium mariscoides*), Baltic rush (*Juncus balticus*), Kalm's St. Johnswort (*Hypericum kalmianum*) and/or shrubby cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*). **48**
47B. Wetland dominated by sedges (*Carex* spp.)..... **50**

48A. Sites in small interdunal wetlands near Lake Michigan; dominated by Kalm's St. Johnswort (*Hypericum kalmianum*), twig-rush (*Cladium mariscoides*) and baltic rush (*Juncus balticus*) with sparse shrubby cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*).....
***Dasiphora fruicosa* ssp. *floribunda* / *Cladium mariscoides* - *Juncus balticus* - (*Rhynchospora capillacea*) Herbaceus Vegetation [CEGL005105]**
48B. Sites not as above..... **49**

49A. Wetland on shores of inland lakes; dominated by twig-rush (*Cladium mariscoides*); *Lobelia kalmii* and/or *Carex viridula* >1% are diagnostic though not always present .....
***Calamagrostis canadensis* - *Carex viridula* - *Cladium mariscoides* - *Lobelia kalmia* Herbaceous Vegetation [CEGL005115]**
49B. Wetland dominated by beak-rush (*Rynchospora capillacea*) and hardstem bulrush (*Schoenoplectus acutus*) in marly depression; sign of past beaver flooding. Plant association uncommon. .....
***Rhynchospora capitellata* - *Rhexia virginica* - *Rhynchospora scirpoides* - *Schoenoplectus hallii* Herbaceous Vegetation [CEGL005108]**

50A. Wetland dominated by tussock sedge (*Carex stricta*). .....
***Carex stricta* - *Carex* spp. Herbaceous Vegetation [CEGL002258]**
50B. Wetland dominated by tall, wide-leaved or narrow-leaved sedges (*Carex* spp.)..... **51**

51A. Wetland primarily dominated by tall, wide-leaved sedges such as *Carex aquatilis, C. tuckermanii, C. rostrata, C. utriculata*, and/or wool-grass (*Scirpus cyperinus*), and bulrush (*S. atrovirens*). Three-way sedge (*Dulichium arundinaceum*) and eastern marsh-fern (*Thelypteris palustris*) may also be common to co-dominant. Shrub cover <25% and open-water pools may be present.
***Carex* (*rostrata, utriculata*) - *Carex lacustris* - (*Carex vesicaria*) Herbaceous Vegetation [CEGL002257]**
51B. Wetland primarily dominated by tall, narrow-leaved sedges, particularly *Carex lasiocarpa*. Often found on a floating mat at the margins of lakes and streams. Pools of open water and/or unvegetated patches common. .....
***Carex lasiocarpa* - (*Carex rostrata*) - *Equisetum fluviatile* Herbaceous Vegetation [CEGL005229]**

52A. Pond or open water community dominated by floating aquatic macrophytes. .....
***Nymphaea odorata* - *Nuphar lutea* (ssp. *pumila*, ssp. *variegata*) Herbaceous Vegetation [CEGL002562]**

52B. Pond or open water community dominated by submergent aquatic macrophytes. .....
***Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation [CEGL002282]**

Appendix D: List of Plant Species

Explanation of the Species List

Plant taxa were identified and documented from vegetation sample plots and accuracy assessment sites collected for the Sleeping Bear Dunes National Lakeshore (SLBE) vegetation mapping project. Plant taxa, along with other sample data, were entered into the National Park Service PLOTS Database Version 2 (NatureServe 2005) for subsequent analyses (plant community descriptions and map assessment). Table D-1 is an export of all plant taxa generated from the PLOTS Database for this project. Note that this list includes taxa identified to the genus, species, and sub-species level. This list is not intended to be comprehensive of every taxon at the SLBE. The plant taxa list is organized alphabetically by scientific name. Nomenclature follows the PLANTS database (U.S. Department of Agriculture 2004).

Table D-1. Plant species list of Sleeping Bear Dunes National Lakeshore.

Scientific Name	Common Name	Family
Abies balsamea	balsam fir	Pinaceae
Acer pensylvanicum	striped maple	Aceraceae
Acer rubrum	red maple	Aceraceae
Acer saccharum	sugar maple	Aceraceae
Acer spicatum	mountain maple	Aceraceae
Achillea millefolium	common yarrow	Asteraceae
Acorus	sweetflag	Acoraceae
Actaea	baneberry	Ranunculaceae
Actaea pachypoda	white baneberry	Ranunculaceae
Actaea rubra	red baneberry	Ranunculaceae
Adiantum pedatum	northern maidenhair	Pteridaceae
Agalinis purpurea	purple false foxglove	Scrophulariaceae
Agrimonia gryposepala	tall hairy agrimony	Rosaceae
Agropyron	wheatgrass	Poaceae
Agrostis	bentgrass	Poaceae
Agrostis gigantea	redtop	Poaceae
Agrostis hyemalis	winter bentgrass	Poaceae
Agrostis perennans	upland bentgrass	Poaceae
Alliaria petiolata	garlic mustard	Brassicaceae
Allium tricoccum	wild leek	Liliaceae
Alnus incana	gray alder	Betulaceae
Alnus incana ssp. *rugosa*	speckled alder	Betulaceae
Alyssum alyssoides	pale madwort	Brassicaceae
Amelanchier	serviceberry	Rosaceae
Amelanchier arborea	common serviceberry	Rosaceae
Amelanchier laevis	Allegheny serviceberry	Rosaceae
Ammophila breviligulata	American beachgrass	Poaceae
Andromeda polifolia var. *glaucophylla*	bog rosemary	Ericaceae
Anemone canadensis	Canadian anemone	Ranunculaceae
Anemone cylindrica	candle anemone	Ranunculaceae
Angelica atropurpurea	purplestem angelica	Apiaceae
Antennaria neglecta	field pussytoes	Asteraceae
Apocynum androsaemifolium	spreading dogbane	Apocynaceae
Apocynum cannabinum	Indianhemp	Apocynaceae
Aquilegia canadensis	red columbine	Ranunculaceae
Arabis	rockcress	Brassicaceae

Scientific Name	Common Name	Family
Arabis lyallii	Lyall's rockcress	Brassicaceae
Arabis lyrata	lyrate rockcress	Brassicaceae
Aralia nudicaulis	wild sarsaparilla	Araliaceae
Aralia racemosa	American spikenard	Araliaceae
Arctium minus	lesser burrdock	Asteraceae
Arctostaphylos uva-ursi	kinnikinnick	Ericaceae
Argentina anserina	silverweed cinquefoil	Rosaceae
Arisaema triphyllum	Jack in the pulpit	Araceae
Arisaema triphyllum ssp. *triphyllum*	Jack in the pulpit	Araceae
Artemisia campestris	wormwood, field sagewort	Asteraceae
Artemisia campestris ssp. *caudata*	wormwood, field sagewort	Asteraceae
Artemisia ludoviciana ssp. *candicans*	white sagebrush	Asteraceae
Asclepias incarnata	swamp milkweed	Asclepiadaceae
Asclepias syriaca	common milkweed	Asclepiadaceae
Athyrium filix-femina	common ladyfern	Dryopteridaceae
Berberis thunbergii	Japanese barberry	Berberidaceae
Berberis vulgaris	common barberry	Berberidaceae
Berteroa incana	hoary false madwort	Brassicaceae
Betula alleghaniensis	yellow birch	Betulaceae
Betula papyrifera	paper birch	Betulaceae
Betula pumila	bog birch	Betulaceae
Bidens	beggarticks	Asteraceae
Bidens cernua	nodding beggartick	Asteraceae
Bidens connata	purplestem beggarticks	Asteraceae
Boehmeria cylindrica	smallspike false nettle	Urticaceae
Botrychium	grapefern	Ophioglossaceae
Botrychium virginianum	rattlesnake fern	Ophioglossaceae
Bromus	brome	Poaceae
Bromus inermis	smooth brome	Poaceae
Bromus kalmii	arctic brome	Poaceae
Cakile edentula	American searocket	Brassicaceae
Calamagrostis canadensis	bluejoint	Poaceae
Calamagrostis stricta ssp. *inexpansa*	northern reedgrass	Poaceae
Calamovilfa longifolia	prairie sandreed	Poaceae
Caltha palustris	yellow marsh marigold	Ranunculaceae
Campanula	bellflower	Campanulaceae
Campanula aparinoides	marsh bellflower	Campanulaceae
Campanula rotundifolia	bluebell bellflower	Campanulaceae
Carex	sedge	Cyperaceae
Carex albursina	white bear sedge	Cyperaceae
Carex aquatilis	water sedge	Cyperaceae
Carex arctata	drooping woodland sedge	Cyperaceae
Carex aurea	golden sedge	Cyperaceae
Carex bebbii	Bebb's sedge	Cyperaceae
Carex brunnescens	brownish sedge	Cyperaceae
Carex buxbaumii	Buxbaum's sedge	Cyperaceae
Carex canescens	silvery sedge	Cyperaceae
Carex communis	fibrousroot sedge	Cyperaceae
Carex comosa	longhair sedge	Cyperaceae

Scientific Name	Common Name	Family
Carex crinita	fringed sedge	Cyperaceae
Carex cumulata	clustered sedge	Cyperaceae
Carex deweyana	Dewey sedge	Cyperaceae
Carex disperma	softleaf sedge	Cyperaceae
Carex eburnea	bristleleaf sedge	Cyperaceae
Carex flava	yellow sedge	Cyperaceae
Carex gracillima	graceful sedge	Cyperaceae
Carex grayi	Gray's sedge	Cyperaceae
Carex hystericina	bottlebrush sedge	Cyperaceae
Carex interior	inland sedge	Cyperaceae
Carex intumescens	greater bladder sedge	Cyperaceae
Carex lacustris	hairy sedge	Cyperaceae
Carex lasiocarpa	woollyfruit sedge	Cyperaceae
Carex laxiculmis	spreading sedge	Cyperaceae
Carex laxiflora	broad looseflower sedge	Cyperaceae
Carex leptalea	bristlystalked sedge	Cyperaceae
Carex oligocarpa	richwoods sedge	Cyperaceae
Carex oligosperma	fewseed sedge	Cyperaceae
Carex pedunculata	longstalk sedge	Cyperaceae
Carex pellita	woolly sedge	Cyperaceae
Carex pensylvanica	Pennsylvania sedge	Cyperaceae
Carex plantaginea	plantainleaf sedge	Cyperaceae
Carex projecta	necklace sedge	Cyperaceae
Carex retrorsa	knotsheath sedge	Cyperaceae
Carex rosea	rosy sedge	Cyperaceae
Carex rostrata	beaked sedge	Cyperaceae
Carex scabrata	eastern rough sedge	Cyperaceae
Carex schweinitzii	Schweinitz's sedge	Cyperaceae
Carex stipata	owlfruit sedge	Cyperaceae
Carex stricta	upright sedge	Cyperaceae
Carex trisperma	threeseeded sedge	Cyperaceae
Carex viridula	little green sedge	Cyperaceae
Carex vulpinoidea	fox sedge	Cyperaceae
Castanea dentata	American chestnut	Fagaceae
Caulophyllum thalictroides	blue cohosh	Berberidaceae
Ceanothus americanus	New Jersey tea	Rhamnaceae
Celastrus scandens	American bittersweet	Celastraceae
Centaurea biebersteinii	spotted knapweed	Asteraceae
Cephalanthus occidentalis	common buttonbush	Rubiaceae
Cephaloziella		Cephaloziellaceae
Ceratophyllum	hornwort	Ceratophyllaceae
Ceratophyllum demersum	coon's tail	Ceratophyllaceae
Chamaedaphne calyculata	leatherleaf	Ericaceae
Chamaesyce maculata	spotted sandmat	Euphorbiaceae
Chamaesyce polygonifolia	seaside sandmat	Euphorbiaceae
Chamerion angustifolium	fireweed	Onagraceae
Chimaphila umbellata	pipsissewa	Pyrolaceae
Cicuta bulbifera	bulblet-bearing water hemlock	Apiaceae
Cicuta maculata	spotted water hemlock	Apiaceae

Scientific Name	Common Name	Family
Circaea alpina	small enchanter's nightshade	Onagraceae
Circaea lutetiana	broadleaf enchanter's nightshade	Onagraceae
Cirsium arvense	Canada thistle	Asteraceae
Cirsium muticum	swamp thistle	Asteraceae
Cirsium palustre	marsh thistle	Asteraceae
Cirsium pitcheri	Pitcher’s thistle	Asteraceae
Cirsium vulgare	bull thistle	Asteraceae
Cladina	reindeer lichen	Cladoniaceae
Cladium	sawgrass	Cyperaceae
Cladium mariscoides	smooth sawgrass	Cyperaceae
Cladonia	cup lichen	Cladoniaceae
Clematis virginiana	devil's darning needles	Ranunculaceae
Clinopodium vulgare	wild basil	Lamiaceae
Clintonia borealis	bluebead	Liliaceae
Comandra umbellata	bastard toadflax	Santalaceae
Comarum palustre	purple marshlocks	Rosaceae
Conopholis americana	American squawroot	Orobanchaceae
Convallaria majuscula	American lily of the valley	Liliaceae
Coptis trifolia	threeleaf goldthread	Ranunculaceae
Coreopsis lanceolata	lanceleaf tickseed	Asteraceae
Corispermum americanum var. *rydbergii*	American bugseed	Chenopodiaceae
Cornus alternifolia	alternateleaf dogwood	Cornaceae
Cornus amomum	silky dogwood	Cornaceae
Cornus canadensis	bunchberry dogwood	Cornaceae
Cornus florida	flowering dogwood	Cornaceae
Cornus rugosa	roundleaf dogwood	Cornaceae
Cornus sericea	redosier dogwood	Cornaceae
Cornus sericea ssp. *sericea*	redosier dogwood	Cornaceae
Corylus cornuta	beaked hazelnut	Betulaceae
Crataegus	hawthorn	Rosaceae
Cynoglossum officinale	gypsyflower	Boraginaceae
Cynoglossum virginianum var. *boreale*	wild comfrey	Boraginaceae
Cyperus	flatsedge	Cyperaceae
Cypripedium acaule	moccasin flower	Orchidaceae
Cypripedium arietinum	ram's head lady's slipper	Orchidaceae
Cypripedium parviflorum	lesser yellow lady's slipper	Orchidaceae
Cystopteris bulbifera	bulblet bladderfern	Dryopteridaceae
Dactylis glomerata	orchardgrass	Poaceae
Danthonia	oatgrass	Poaceae
Danthonia spicata	poverty oatgrass	Poaceae
Dasiphora floribunda	shrubby cinquefoil	Rosaceae
Decodon verticillatus	swamp loosestrife	Lythraceae
Deschampsia	hairgrass	Poaceae
Deschampsia caespitosa	tufted hairgrass	Poaceae
Deschampsia flexuosa	wavy hairgrass	Poaceae
Dianthus armeria	Deptford pink	Caryophyllaceae
Dianthus deltoides	maiden pink	Caryophyllaceae
Dicentra	bleeding heart	Fumariaceae
Dicentra canadensis	squirrel corn	Fumariaceae

Scientific Name	Common Name	Family
Dichanthelium acuminatum var. *fasciculatum*	western panicgrass	Poaceae
Dichanthelium villosissimum var. *praecocius*	whitehair rosette grass	Poaceae
Diervilla lonicera	northern bush honeysuckle	Caprifoliaceae
Dirca palustris	eastern leatherwood	Thymelaeaceae
Drosera	sundew	Droseraceae
Drosera intermedia	spoonleaf sundew	Droseraceae
Drosera rotundifolia	roundleaf sundew	Droseraceae
Dryopteris	woodfern	Dryopteridaceae
Dryopteris carthusiana	spinulose woodfern	Dryopteridaceae
Dryopteris cristata	crested woodfern	Dryopteridaceae
Dryopteris intermedia	intermediate woodfern	Dryopteridaceae
Dryopteris marginalis	marginal woodfern	Dryopteridaceae
Dulichium arundinaceum	threeway sedge	Cyperaceae
Elaeagnus umbellata	autumn olive	Elaeagnaceae
Eleocharis	spikerush	Cyperaceae
Eleocharis elliptica	elliptic spikerush	Cyperaceae
Eleocharis palustris	common spikerush	Cyperaceae
Elodea canadensis	Canadian waterweed	Hydrocharitaceae
Elymus canadensis	Canada wildrye	Poaceae
Elymus hystrix	eastern bottlebrush grass	Poaceae
Elymus hystrix var. *hystrix*	eastern bottlebrush grass	Poaceae
Elymus lanceolatus	streambank wheatgrass	Poaceae
Elymus lanceolatus ssp. *lanceolatus*	streambank wheatgrass	Poaceae
Elymus repens	quackgrass	Poaceae
Elymus trachycaulus ssp. *trachycaulus*	slender wheatgrass	Poaceae
Epifagus virginiana	beechdrops	Orobanchaceae
Epigaea repens	trailing arbutus	Ericaceae
Epilobium ciliatum	fringed willowherb	Onagraceae
Epilobium leptophyllum	bog willowherb	Onagraceae
Epilobium parviflorum	smallflower hairy willowherb	Onagraceae
Epipactis helleborine	broadleaf helleborine	Orchidaceae
Equisetum	horsetail	Equisetaceae
Equisetum arvense	field horsetail	Equisetaceae
Equisetum fluviatile	water horsetail	Equisetaceae
Equisetum hyemale	scouringrush horsetail	Equisetaceae
Equisetum pratense	meadow horsetail	Equisetaceae
Equisetum scirpoides	dwarf scouringrush	Equisetaceae
Equisetum sylvaticum	woodland horsetail	Equisetaceae
Equisetum variegatum	variegated scouringrush	Equisetaceae
Erechtites hieracifolia	burnweed	Asteraceae
Eriogonum roseum	wand buckwheat	Polygonaceae
Eriophorum	cottongrass	Cyperaceae
Eriophorum virginicum	tawny cottongrass	Cyperaceae
Eupatorium maculatum	spotted joepyeweed	Asteraceae
Eupatorium perfoliatum	common boneset	Asteraceae
Euphorbia	spurge	Euphorbiaceae
Euphorbia cyparissias	cypress spurge	Euphorbiaceae
Eurybia macrophylla	bigleaf aster	Asteraceae
Euthamia graminifolia	flat-top goldentop	Asteraceae

Scientific Name	Common Name	Family
Fagus grandifolia	American beech	Fagaceae
Festuca	fescue	Poaceae
Festuca ovina	sheep fescue	Poaceae
Festuca saximontana	Rocky Mountain fescue	Poaceae
Festuca subverticillata	nodding fescue	Poaceae
Fragaria vesca	woodland strawberry	Rosaceae
Fragaria virginiana	Virginia strawberry	Rosaceae
Fraxinus americana	white ash	Oleaceae
Fraxinus nigra	black ash	Oleaceae
Fraxinus pennsylvanica	green ash	Oleaceae
Galium	bedstraw	Rubiaceae
Galium aparine	stickywilly	Rubiaceae
Galium circaezans var. *circaezans*	licorice bedstraw	Rubiaceae
Galium lanceolatum	lanceleaf wild licorice	Rubiaceae
Galium palustre	common marsh bedstraw	Rubiaceae
Galium tinctorium	stiff marsh bedstraw	Rubiaceae
Galium triflorum	fragrant bedstraw	Rubiaceae
Gaultheria hispidula	creeping snowberry	Ericaceae
Gaultheria procumbens	eastern teaberry	Ericaceae
Gaylussacia baccata	black huckleberry	Ericaceae
Geocaulon lividum	false toadflax	Santalaceae
Geranium	geranium	Geraniaceae
Geranium maculatum	spotted geranium	Geraniaceae
Geum	avens	Rosaceae
Geum aleppicum	yellow avens	Rosaceae
Glyceria	mannagrass	Poaceae
Glyceria borealis	small floating mannagrass	Poaceae
Glyceria canadensis	rattlesnake mannagrass	Poaceae
Glyceria grandis	American mannagrass	Poaceae
Glyceria striata	fowl mannagrass	Poaceae
Goodyera	rattlesnake plantain	Orchidaceae
Goodyera oblongifolia	western rattlesnake plantain	Orchidaceae
Gymnocarpium dryopteris	western oakfern	Dryopteridaceae
Gypsophila	babysbreath	Caryophyllaceae
Gypsophila elegans	showy babysbreath	Caryophyllaceae
Gypsophila paniculata	babysbreath gypsophila	Caryophyllaceae
Hackelia virginiana	beggarslice	Boraginaceae
Hamamelis virginiana	American witchhazel	Hamamelidaceae
Hebeclinium macrophyllum	largeleaf thoroughwort	Asteraceae
Hemerocallis fulva	orange daylily	Liliaceae
Hepatica nobilis var. *acuta*	sharplobe hepatica	Ranunculaceae
Hepatica nobilis var. *obtusa*	roundlobe hepatica	Ranunculaceae
Heracleum maximum	common cowparsnip	Apiaceae
Hesperis matronalis	dames rocket	Brassicaceae
Hieracium	hawkweed	Asteraceae
Hieracium aurantiacum	orange hawkweed	Asteraceae
Hieracium canadense	Canadian hawkweed	Asteraceae
Hieracium piloselloides	tall hawkweed	Asteraceae
Hieracium umbellatum	narrowleaf hawkweed	Asteraceae

Scientific Name	Common Name	Family
Hieracium venosum	rattlesnakeweed	Asteraceae
Hudsonia tomentosa	woolly beachheather	Cistaceae
Hydrophyllum virginianum	Shawnee salad	Hydrophyllaceae
Hypericum	St. Johnswort	Clusiaceae
Hypericum kalmianum	Kalm's St. Johnswort	Clusiaceae
Hypericum majus	large St. Johnswort	Clusiaceae
Hypericum perforatum	common St. Johnswort	Clusiaceae
Ilex verticillata	common winterberry	Aquifoliaceae
Impatiens capensis	jewelweed	Balsaminaceae
Iris germanica	German iris	Iridaceae
Iris versicolor	harlequin blueflag	Iridaceae
Iris virginica	Virginia iris	Iridaceae
Juncus	rush	Juncaceae
Juncus balticus	Baltic rush	Juncaceae
Juncus brevicaudatus	narrowpanicle rush	Juncaceae
Juncus effusus	common rush	Juncaceae
Juncus nodosus	knotted rush	Juncaceae
Juncus pelocarpus	brownfruit rush	Juncaceae
Juniperus communis	common juniper	Cupressaceae
Juniperus horizontalis	creeping juniper	Cupressaceae
Kalmia polifolia	bog laurel	Ericaceae
Koeleria macrantha	prairie Junegrass	Poaceae
Lactuca canadensis	Canada lettuce	Asteraceae
Laportea canadensis	Canadian woodnettle	Urticaceae
Larix laricina	tamarack	Pinaceae
Lathyrus japonicus	beach pea	Fabaceae
Lathyrus palustris	marsh pea	Fabaceae
Ledum groenlandicum	bog Labrador tea	Ericaceae
Leersia oryzoides	rice cutgrass	Poaceae
Lemna	duckweed	Lemnaceae
Lemna minor	common duckweed	Lemnaceae
Leucanthemum vulgare	oxeye daisy	Asteraceae
Leucobryum glaucum	leucobryum moss	Leucobryaceae
Lichen		Phyllachoraceae
Lilium philadelphicum	wood lily	Liliaceae
Lindera benzoin	northern spicebush	Lauraceae
Linnaea borealis	twinflower	Caprifoliaceae
Linnaea borealis ssp. *americana*	twinflower	Caprifoliaceae
Liparis loeselii	yellow widelip orchid	Orchidaceae
Lithospermum caroliniense	Carolina puccoon	Boraginaceae
Lobelia cardinalis	cardinalflower	Campanulaceae
Lobelia kalmii	Ontario lobelia	Campanulaceae
Lonicera	honeysuckle	Caprifoliaceae
Lonicera canadensis	American fly honeysuckle	Caprifoliaceae
Lonicera dioica	limber honeysuckle	Caprifoliaceae
Lonicera morrowii	Morrow's honeysuckle	Caprifoliaceae
Lonicera tatarica	Tatarian honeysuckle	Caprifoliaceae
Lycopodium	clubmoss	Lycopodiaceae
Lycopodium complanatum	groundcedar	Lycopodiaceae

Scientific Name	Common Name	Family
Lycopodium obscurum	rare clubmoss	Lycopodiaceae
Lycopodium tristachyum	deeproot clubmoss	Lycopodiaceae
Lycopus americanus	American water horehound	Lamiaceae
Lycopus uniflorus	northern bugleweed	Lamiaceae
Lysimachia thyrsiflora	tufted loosestrife	Primulaceae
Mahonia repens	creeping barberry	Berberidaceae
Maianthemum	mayflower	Liliaceae
Maianthemum canadense	Canada mayflower	Liliaceae
Maianthemum racemosum	feathery false lily of the vally	Liliaceae
Maianthemum racemosum ssp. *racemosum*	feathery false lily of the vally	Liliaceae
Maianthemum stellatum	starry false lily of the vally	Liliaceae
Maianthemum trifolium	threeleaf false lily of the vally	Liliaceae
Malus	apple	Rosaceae
Malus pumila	paradise apple	Rosaceae
Marchantia		Marchantiaceae
Matteuccia struthiopteris	ostrich fern	Dryopteridaceae
Medeola virginiana	Indian cucumber	Liliaceae
Medicago lupulina	black medick	Fabaceae
Melampyrum lineare	narrowleaf cowwheat	Scrophulariaceae
Melilotus alba	white sweetclover	Fabaceae
Mentha arvensis	wild mint	Lamiaceae
Mentha pulegium	pennyroyal	Lamiaceae
Menyanthes trifoliata	buckbean	Menyanthaceae
Milium effusum	American milletgrass	Poaceae
Mimulus glabratus var. *michiganensis*	Michigan monkeyflower	Scrophulariaceae
Mimulus ringens	Allegheny monkeyflower	Scrophulariaceae
Minuartia michauxii var. *michauxii*	Michaux's stitchwort	Caryophyllaceae
Mitchella repens	partridgeberry	Rubiaceae
Mitella diphylla	twoleaf miterwort	Saxifragaceae
Mitella nuda	naked miterwort	Saxifragaceae
Monarda fistulosa	wild bergamot	Lamiaceae
Monarda punctata	spotted beebalm	Lamiaceae
Monotropa uniflora	Indianpipe	Monotropaceae
Muhlenbergia mexicana	Mexican muhly	Poaceae
Myosotis scorpioides	true forget-me-not	Boraginaceae
Myrica gale	sweetgale	Myricaceae
Myriophyllum tenellum	slender watermilfoil	Haloragaceae
Najas flexilis	nodding waternymph	Najadaceae
Nemopanthus mucronatus	catberry	Aquifoliaceae
Nuphar lutea	yellow pond-lily	Nymphaeaceae
Nuphar lutea ssp. *variegata*	varigated yellow pond-lily	Nymphaeaceae
Nymphaea odorata	American white waterlily	Nymphaeaceae
Oenothera oakesiana	Oakes' evening-primrose	Onagraceae
Oligoneuron rigidum var. *humile*	stiff goldenrod	Asteraceae
Onoclea sensibilis	sensitive fern	Dryopteridaceae
Orthilia secunda	sidebells wintergreen	Pyrolaceae
Oryzopsis	ricegrass	Poaceae
Oryzopsis asperifolia	roughleaf ricegrass	Poaceae
Osmorhiza berteroi	sweetcicely	Apiaceae

Scientific Name	Common Name	Family
Osmorhiza claytonii	Clayton's sweetroot	Apiaceae
Osmorhiza longistylis	longstyle sweetroot	Apiaceae
Osmunda cinnamomea	cinnamon fern	Osmundaceae
Osmunda regalis	royal fern	Osmundaceae
Ostrya virginiana	Chisos hophornbeam	Betulaceae
Packera paupercula	balsam groundsel	Asteraceae
Panax quinquefolius	American ginseng	Araliaceae
Panicum	panicgrass	Poaceae
Panicum virgatum	switchgrass	Poaceae
Parnassia glauca	fen grass of Parnassus	Saxifragaceae
Parthenocissus quinquefolia	Virginia creeper	Vitaceae
Pedicularis canadensis	Canadian lousewort	Scrophulariaceae
Phalaris arundinacea	reed canarygrass	Poaceae
Philadelphus coronarius	sweet mock orange	Hydrangeaceae
Phleum pratense	timothy	Poaceae
Photinia floribunda	purple chokeberry	Rosaceae
Photinia melanocarpa	black chokeberry	Rosaceae
Phragmites	reed	Poaceae
Phragmites australis	common reed	Poaceae
Phryma leptostachya	American lopseed	Verbenaceae
Picea glauca	white spruce	Pinaceae
Picea mariana	black spruce	Pinaceae
Pilea pumila	Canadian clearweed	Urticaceae
Pinus banksiana	jack pine	Pinaceae
Pinus resinosa	red pine	Pinaceae
Pinus strobus	eastern white pine	Pinaceae
Pinus strobus	red pine	Pinaceae
Pinus sylvestris	Scotch pine	Pinaceae
Piptatherum racemosum	blackseed ricegrass	Poaceae
Platanthera obtusata	bluntleaved orchid	Orchidaceae
Poa	bluegrass	Poaceae
Poa compressa	Canada bluegrass	Poaceae
Poa palustris	fowl bluegrass	Poaceae
Poa pratensis	Kentucky bluegrass	Poaceae
Poitea paucifolia	retama	Fabaceae
Polygala paucifolia	gaywings	Polygalaceae
Polygala polygama	racemed milkwort	Polygalaceae
Polygonatum	Solomon's seal	Liliaceae
Polygonatum pubescens	hairy Solomon's seal	Liliaceae
Polygonum	knotweed	Polygonaceae
Polygonum amphibium	water knotweed	Polygonaceae
Polygonum hydropiper	marshpepper knotweed	Polygonaceae
Polygonum punctatum	dotted smartweed	Polygonaceae
Populus	cottonwood	Salicaceae
Populus balsamifera	balsam poplar	Salicaceae
Populus deltoides	eastern cottonwood	Salicaceae
Populus grandidentata	bigtooth aspen	Salicaceae
Populus nigra	Lombardy poplar	Salicaceae
Populus tremula	European aspen	Salicaceae

Scientific Name	Common Name	Family
Populus tremuloides	quaking aspen	Salicaceae
Potamogeton	pondweed	Potamogetonaceae
Potamogeton amplifolius	largeleaf pondweed	Potamogetonaceae
Potamogeton crispus	curly pondweed	Potamogetonaceae
Potamogeton gramineus	variableleaf pondweed	Potamogetonaceae
Potamogeton illinoensis	Illinois pondweed	Potamogetonaceae
Potamogeton richardsonii	Richardson's pondweed	Potamogetonaceae
Potentilla	cinquefoil	Rosaceae
Prenanthes alata	western rattlesnakeroot	Asteraceae
Prenanthes alba	white rattlesnakeroot	Asteraceae
Proserpinaca palustris	marsh mermaidweed	Haloragaceae
Prunella vulgaris	common selfheal	Lamiaceae
Prunus	plum	Rosaceae
Prunus mahaleb	Mahaleb cherry	Rosaceae
Prunus pensylvanica	pin cherry	Rosaceae
Prunus pumila	sandcherry	Rosaceae
Prunus serotina	black cherry	Rosaceae
Prunus virginiana	chokecherry	Rosaceae
Psidium longipes var. *longipes*	mangroveberry	Myrtaceae
Pteridium aquilinum	western brackenfern	Dennstaedtiaceae
Pulsatilla patens ssp. *multifida*	cutleaf anemone	Ranunculaceae
Pyrola americana	American wintergreen	Pyrolaceae
Pyrola elliptica	waxflower shinleaf	Pyrolaceae
Quercus alba	white oak	Fagaceae
Quercus coccinea	scarlet oak	Fagaceae
Quercus rubra	northern red oak	Fagaceae
Ranunculus	buttercup	Ranunculaceae
Ranunculus abortivus	littleleaf buttercup	Ranunculaceae
Ranunculus flammula var. *filiformis*	greater creeping spearwort	Ranunculaceae
Ranunculus longirostris	longbeak buttercup	Ranunculaceae
Ranunculus recurvatus	blisterwort	Ranunculaceae
Ranunculus sceleratus	cursed buttercup	Ranunculaceae
Rhamnus alnifolia	alderleaf buckthorn	Rhamnaceae
Rhus hirta	staghorn sumac	Anacardiaceae
Rhynchospora alba	white beaksedge	Cyperaceae
Rhynchospora capillacea	needle beaksedge	Cyperaceae
Ribes	currant	Grossulariaceae
Ribes cynosbati	eastern prickly gooseberry	Grossulariaceae
Robinia pseudoacacia	black locust	Fabaceae
Rorippa nasturtium-aquaticum	watercress	Brassicaceae
Rorippa sarmentosa	longrunner	Brassicaceae
Rosa	rose	Rosaceae
Rosa acicularis	prickly rose	Rosaceae
Rosa blanda	smooth rose	Rosaceae
Rosa eglanteria	sweetbriar rose	Rosaceae
Rosa multiflora	multiflora rose	Rosaceae
Rosa palustris	swamp rose	Rosaceae
Rubus	blackberry	Rosaceae
Rubus hispidus	bristly dewberry	Rosaceae

Scientific Name	Common Name	Family
Rubus idaeus	American red raspberry	Rosaceae
Rubus idaeus ssp. *strigosus*	grayleaf red raspberry	Rosaceae
Rubus pubescens	dwarf red blackberry	Rosaceae
Rudbeckia hirta var. *pulcherrima*	blackeyed Susan	Asteraceae
Rumex acetosella	common sheep sorrel	Polygonaceae
Rumex obtusifolius	bitter dock	Polygonaceae
Sagittaria latifolia	broadleaf arrowhead	Alismataceae
Salix	willow	Salicaceae
Salix candida	sageleaf willow	Salicaceae
Salix discolor	pussy willow	Salicaceae
Salix eriocephala	Missouri River willow	Salicaceae
Salix exigua	narrowleaf willow	Salicaceae
Salix myricoides	bayberry willow	Salicaceae
Salix petiolaris	meadow willow	Salicaceae
Sambucus	elderberry	Caprifoliaceae
Sambucus nigra ssp. *canadensis*	common elderberry	Caprifoliaceae
Sambucus racemosa	red elderberry	Caprifoliaceae
Sambucus racemosa var. *racemosa*	red elderberry	Caprifoliaceae
Sanguinaria canadensis	bloodroot	Papaveraceae
Saponaria officinalis	bouncingbet	Caryophyllaceae
Sarracenia purpurea	purple pitcherplant	Sarraceniaceae
Schizachne purpurascens	false melic	Poaceae
Schizachyrium scoparium	little bluestem	Poaceae
Schoenoplectus	bulrush	Cyperaceae
Schoenoplectus acutus	hardstem bulrush	Cyperaceae
Schoenoplectus acutus var. *acutus*	hardstem bulrush	Cyperaceae
Schoenoplectus americanus	chairmaker's bulrush	Cyperaceae
Schoenoplectus tabernaemontani	softstem bulrush	Cyperaceae
Scirpus	bulrush	Cyperaceae
Scirpus atrovirens	green bulrush	Cyperaceae
Scirpus cyperinus	woolgrass	Cyperaceae
Scutellaria galericulata	marsh skullcap	Lamiaceae
Scutellaria lateriflora	blue skullcap	Lamiaceae
Selaginella	spikemoss	Selaginellaceae
Selenia	selenia	Brassicaceae
Senecio vulgaris	old-man-in-the-Spring	Asteraceae
Shepherdia argentea	silver buffaloberry	Elaeagnaceae
Shepherdia canadensis	russet buffaloberry	Elaeagnaceae
Silene	catchfly	Caryophyllaceae
Silene latifolia ssp. *alba*	bladder campion	Caryophyllaceae
Silene rotundifolia	roundleaf catchfly	Caryophyllaceae
Silene vulgaris	maidenstears	Caryophyllaceae
Solanum dulcamara	climbing nightshade	Solanaceae
Solanum sisymbriifolium	sticky nightshade	Solanaceae
Solidago	goldenrod	Asteraceae
Solidago caesia	wreath goldenrod	Asteraceae
Solidago canadensis	Canada goldenrod	Asteraceae
Solidago canadensis var. *scabra*	Canada goldenrod	Asteraceae
Solidago flexicaulis	zigzag goldenrod	Asteraceae

Scientific Name	Common Name	Family
Solidago gigantea	giant goldenrod	Asteraceae
Solidago nemoralis	gray goldenrod	Asteraceae
Solidago patula	roundleaf goldenrod	Asteraceae
Solidago rugosa	wrinkleleaf goldenrod	Asteraceae
Solidago simplex	Mt. Albert goldenrod	Asteraceae
Solidago uliginosa	bog goldenrod	Asteraceae
Sorbus decora	northern mountain ash	Rosaceae
Sparganium	bur-reed	Sparganiaceae
Sparganium erectum ssp. stoloniferum	simplestem bur-reed	Sparganiaceae
Sparganium natans	small bur-reed	Sparganiaceae
Sphagnum	sphagnum	Sphagnaceae
Sphenopholis intermedia	slender wedgescale	Poaceae
Spiraea alba	white meadowsweet	Rosaceae
Spiranthes romanzoffiana	hooded ladies'-tresses	Orchidaceae
Spiranthes tuberosa	little ladies'-tresses	Orchidaceae
Spirodela polyrhiza	giant duckweed	Lemnaceae
Sporobolus cryptandrus	sand dropseed	Poaceae
Stachys palustris	marsh hedgenettle	Lamiaceae
Stellaria graminea	grasslike starwort	Caryophyllaceae
Streptopus amplexifolius	claspleaf twistedstalk	Liliaceae
Streptopus lanceolatus var. *roseus*	twistedstalk	Liliaceae
Stuckenia pectinatus	sago pondweed	Potamogetonaceae
Symphoricarpos albus	common snowberry	Caprifoliaceae
Symphyotrichum laeve var. *laeve*	smooth blue aster	Asteraceae
Symphyotrichum lanceolatum ssp. *lanceolatum* var. *lanceolatum*	white panicle aster	Asteraceae
Symphyotrichum lateriflorum var. *lateriflorum*	calico aster	Asteraceae
Symphyotrichum pilosum var. *pilosum*	hairy white oldfield aster	Asteraceae
Symphyotrichum puniceum var. *puniceum*	purplestem aster	Asteraceae
Syringa vulgaris	common lilac	Oleaceae
Taraxacum officinale	common dandelion	Asteraceae
Taxus canadensis	Canada yew	Taxaceae
Teucrium canadense	Canada germander	Lamiaceae
Thalictrum dioicum	early meadow-rue	Ranunculaceae
Thelypteris palustris	eastern marsh fern	Thelypteridaceae
Thuja occidentalis	northern white cedar	Cupressaceae
Tilia americana	American basswood	Tiliaceae
Toxicodendron radicans	eastern poison ivy	Anacardiaceae
Toxicodendron rydbergii	western poison ivy	Anacardiaceae
Tragia nigricans	dark noseburn	Euphorbiaceae
Tragopogon dubius	yellow salsify	Asteraceae
Tragopogon pratensis	Jack-go-to-bed-at-noon	Asteraceae
Triadenum fraseri	Fraser's marsh St. Johnswort	Clusiaceae
Trichomanes boschianum	Appalachian bristle fern	Hymenophyllaceae
Trientalis borealis	starflower	Primulaceae
Trifolium	clover	Fabaceae
Trillium	trillium	Liliaceae
Trillium grandiflorum	snow trillium	Liliaceae
Tsuga canadensis	eastern hemlock	Pinaceae
Typha	cattail	Typhaceae

Scientific Name	Common Name	Family
Typha angustifolia	narrowleaf cattail	Typhaceae
Typha latifolia	broadleaf cattail	Typhaceae
Ulmus americana	American elm	Ulmaceae
Urtica dioica	stinging nettle	Urticaceae
Utricularia	bladderwort	Lentibulariaceae
Utricularia cornuta	horned bladderwort	Lentibulariaceae
Utricularia intermedia	flatleaf bladderwort	Lentibulariaceae
Uvularia	bellwort	Liliaceae
Uvularia grandiflora	largeflower bellwort	Liliaceae
Vaccinium	blueberry	Ericaceae
Vaccinium angustifolium	lowbush blueberry	Ericaceae
Vaccinium macrocarpon	cranberry	Ericaceae
Vaccinium myrtilloides	velvetleaf huckleberry	Ericaceae
Vaccinium ovalifolium	oval-leaf blueberry	Ericaceae
Vaccinium oxycoccos	small cranberry	Ericaceae
Verbascum thapsus	common mullein	Scrophulariaceae
Verbena hastata	swamp verbena	Verbenaceae
Veronica officinalis	common gypsyweed	Scrophulariaceae
Viburnum	viburnum	Caprifoliaceae
Viburnum acerifolium	mapleleaf viburnum	Caprifoliaceae
Viburnum lentago	nannyberry	Caprifoliaceae
Viburnum opulus	European cranberrybush	Caprifoliaceae
Viburnum opulus var. *americanum*	American cranberrybush	Caprifoliaceae
Viburnum rafinesquianum	downy arrowwood	Caprifoliaceae
Vinca minor	common periwinkle	Apocynaceae
Viola	violet	Violaceae
Viola canadensis	Canadian white violet	Violaceae
Viola nephrophylla	northern bog violet	Violaceae
Viola pubescens	downy yellow violet	Violaceae
Vitis riparia	riverbank grape	Vitaceae
Vulpia octoflora var. *octoflora*	sixweeks fescue	Poaceae
Woodwardia virginica	Virginia chainfern	Blechnaceae
Zigadenus elegans	mountain deathcamas	Liliaceae
Zigadenus elegans ssp. *glaucus*	mountain deathcamas	Liliaceae
Zygodon	zygodon moss	Orthotrichaceae

Appendix E: Descriptions of Map Classes

Explanation of Map-class Descriptions

This appendix to the Main Report of the Sleeping Bear Dunes National Lakeshore (SLBE) vegetation mapping project provides descriptions of the 75 map classes we used to map the SLBE and environs for the National Park Service (NPS) Vegetation Inventory Program (VIP). Of these 75 map classes, 71 represent vegetation types listed within the National Vegetation Classification Standard (NVCS), Version 2 (FGDC 2008), whereas another four represent non-vegetation units (open water, barren land). For those map classes representing floristic types (alliance and association) in the NVCS, we recommend using Appendix B: Descriptions of Vegetation Types and Appendix C: Field Key to Vegetation Types to complement the map-class descriptions in this appendix.

Each map-class description provides the formal map-class name and code we used for mapping. Names for map classes representing floristic types (alliance and association) in the NVCS are the synonym names provided by NatureServe. (For map-class phases, the phase portion of the name is not part of the synonym name.) For map classes representing vegetation types above the floristic level in the NVCS and for non-vegetation features, we derived succinct names to describe the feature.

Commencing each map-class description, we provide the official classification name and code that the map class represents in the NVCS; for non-vegetation map classes, we provide the classification given in the 2001 version of the National Land Cover Database (NLCD) (Homer et al. 2004). Each map class is described with a focus on the SLBE and its immediate environs and not necessarily on the region beyond. Also, descriptions are from a mapping perspective more than from an ecologic perspective; however, some ecologic concepts are inherent to the descriptions, as one would expect when describing the mapping of types in the NVCS. We also discuss how map classes relate to other map classes, because many vegetation types transition into each other. We finally provide a brief explanation of how map classes were analyzed during the accuracy assessment.

Throughout the map-class descriptions, “RD” refers to relative density and “AA” refers to accuracy assessment. Also, when speaking of tree species (e.g., sugar maple, northern white-cedar), it is assumed these are of heights >5 m unless otherwise specified (e.g., shrub-height trees). This assumption includes general references to trees as conifers and hardwoods.

Along with describing the map classes via text, representative ground pictures are also provided to give visual concepts of the vegetation types and non-vegetation features that the map classes represent. It is worth noting that the pictures are a partial representation; to capture all variations within a map class would become daunting.

We organized map classes representing vegetation types by the hierarchy in the NVCS. We organized map classes representing non-vegetation features (e.g., open water) by using the classification in the NLCD. Map classification codes, names, and their crosswalk to the NVCS and the NLCD are listed in Table E-1. The map classification is listed alphabetically by map-class code in Table E-2 at the end of this appendix.

Minimum Mapping Units

Map classes are generally mapped to the NPS VIP minimum mapping unit (MMU) standard of 0.5 ha. For vegetation types unique to the immediate surroundings (e.g., herbaceous wetland within an upland forest setting), we allowed for mapping below the MMU, down to 0.25 ha. In addition, we applied a secondary MMU of 2.0 ha for physiognomic feature changes within a particular map class (e.g., open versus closed forest).

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Table E-1. Map classification with crosswalk to the National Vegetation Classification Standard, Version 2 (FGDC 2008), for the Sleeping Bear Dunes National Lakeshore (Michigan) vegetation mapping project.

[NVCS, National Vegetation Classification Standard; NLCD, National Land Cover Database]

Map-class Code	Map-class Name
1. FOREST & WOODLAND CLASS	
1.C.2.Na. (D008.) Eastern North American Cool Temperate Forest Division	
M153. Central Mesophytic Hardwood Forest Macrogroup	
G021. North-Central Beech - Maple - Basswood - Oak Forest Group	
Acer saccharum - *Fagus grandifolia* - *Betula* spp. / *Maianthemum canadense* Forest Association (CEGL005004)	
FBM	Beech - Maple - Northern Hardwoods Forest
M013. Eastern North American Ruderal Forest & Plantation Macrogroup	
G032. Northern & Central Conifer & Hardwood Plantation Group	
FPE	Conifer Plantation
G030. Northern & Central Hardwood & Conifer Ruderal Forest Group	
FCX	Conifer Ruderal Forest
FDX	Hardwood Ruderal Forest (hardwood mix phase)
FBX	Hardwood Ruderal Forest (black locust phase)
FMX	Conifer - Hardwood Ruderal Forest
M159. Northern & Eastern Pine - Oak Forest, Woodland & Barrens Macrogroup	
G160. Great Lakes Pine Barrens Group	
Pinus banksiana - *Pinus resinosa* - *Pinus strobus* Dune Forest Association (CEGL002589)	
FPD	Great Lakes Dune Pine Forest
G025. White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group	
Pinus banksiana - (*Pinus resinosa*) - *Quercus ellipsoidalis* / *Carex pensylvanica* Forest Association (CEGL002478)	
FJO	Jack Pine - Northern Pin Oak Forest
Pinus resinosa - *Populus tremuloides* / *Diervilla lonicera* - *Vaccinium* spp. Forest Association (CEGL002520)	
FRA	Red Pine - Aspen - Birch Forest
Pinus resinosa / *Vaccinium* spp. Forest Association (CEGL002443)	
FRP	Red Pine / Blueberry Dry Forest
Pinus strobus - (*Pinus resinosa*) - *Quercus rubra* Forest Association (CEGL002480)	
FWO	White Pine - Red Oak Forest
Pinus strobus - *Populus tremuloides* / *Corylus cornuta* Forest Association (CEGL002479)	
FWA	White Pine - Aspen - Birch Forest
Pinus strobus / *Vaccinium* spp. Forest Association (CEGL002444)	
FWP	White Pine / Blueberry Dry-Mesic Forest

Map-class Code	Map-class Name
	M014. Northern Mesic Hardwood & Conifer Forest Macrogroup
	G163. Northern Hardwood - Hemlock - White Pine Forest Group
	Acer saccharum - *Fraxinus americana* - *Tilia americana* / *Acer spicatum* / *Caulophyllum thalictroides* Forest Association (CEGL005008)
FMA	Sugar Maple - Ash - Basswood Northern Rich Mesic Forest
	Populus tremuloides - *Betula papyrifera* - (*Acer rubrum*, *Populus grandidentata*) Forest Association (CEGL002467)
FBR	Aspen - Birch - Red Maple Forest
	Quercus rubra - *Acer saccharum* - (*Betula alleghaniensis*) Forest Association (CEGL002461)
FOM	Northern Red Oak - Sugar Maple Forest
	Thuja occidentalis / *Abies balsamea* - *Acer spicatum* Forest Association (CEGL002449)
FCC	White-cedar - Boreal Conifer Mesic Forest (conifer phase)
FCB	White-cedar - Boreal Conifer Mesic Forest (yellow birch interior phase)
FCM	White-cedar - Boreal Conifer Mesic Forest (maple coastal dune phase)
	Tsuga canadensis - (*Betula alleghaniensis*) Forest Association (CEGL002598)
FHC	Hemlock Mesic Forest
	Tsuga canadensis - *Fagus grandifolia* - (*Acer saccharum*) Great Lakes Forest Association (CEGL005042)
FHB	Great Lakes Hemlock - Beech - Hardwood Forest
	1.C.3.Na. (D011.) Eastern North American Flooded & Swamp Forest Division
	M030. Northern & Central Swamp Forest Macrogroup
	G046. Northern & Central Conifer & Hardwood Alkaline Swamp Group
	Acer rubrum - *Fraxinus* spp. - *Betula papyrifera* / *Cornus canadensis* Forest Association (CEGL002071)
FRM	Red Maple - Ash - Birch Swamp Forest
	Fraxinus nigra - Mixed Hardwoods - Conifers / *Cornus sericea* / *Carex* spp. Forest Association (CEGL002105)
FBA	Black Ash - Mixed Hardwood Swamp
	Larix laricina / *Photinia melanocarpa* / *Sphagnum* spp. Forest Association (CEGL002472)
FTS	Central Tamarack Poor Swamp
	Pinus strobus - (*Acer rubrum*) / *Osmunda* spp. Forest Association (CEGL002482)
FWS	White Pine - Red Maple Swamp
	Thuja occidentalis - *Fraxinus nigra* Forest Association (CEGL005165)
FCA	White-cedar - Black Ash Swamp
	Tsuga canadensis - *Betula alleghaniensis* Saturated Forest Association (CEGL005003)
FHS	Hemlock - Yellow Birch Swamp Wet-Mesic Forest
	M160. Northern & Central Tall Shrub Wetland Macrogroup
	G167. Northern & Central Shrub Swamp Group
	Alnus incana Swamp Shrubland Association (CEGL002381)
SAS	Gray Alder Swamp

Map-class Code	Map-class Name
1.D.1.Na. (D014.) North American Boreal Forest Division	
M037. Eastern & Central North American Boreal Conifer & Hardwood Forest Macrogroup	
G047. Jack Pine - Black Spruce Forest Group	
Pinus banksiana / *Vaccinium* spp. / *Pleurozium schreberi* Forest Association (CEGL002441)	
FJB	Jack Pine / Blueberry / Feathermoss Forest
G048. White Spruce - Balsam Fir Forest Group	
Picea glauca - *Abies balsamea* - *Populus tremuloides* / Mixed Herbs Forest Association (CEGL002475)	
FCP	Spruce - Fir - Aspen Forest
1.D.2.Na. (D016.) North American Boreal Flooded & Swamp Forest Division	
M299. North American Boreal Swamp Forest Macrogroup	
G050. Eastern Black Spruce - Tamarack Acidic Swamp Group	
Picea mariana - (*Larix laricina*) / *Ledum groenlandicum* / *Sphagnum* spp. Forest Association (CEGL005271)	
FSS	Black Spruce - Tamarack / Labrador-tea Poor Swamp (black spruce phase)
FTP	Black Spruce - Tamarack / Labrador-tea Poor Swamp (tamarack phase)
G051. Eastern Tamarack - Conifer Alkaline Swamp Group	
Larix laricina / *Alnus incana* Forest Association (CEGL002471)	
FTR	Northern Tamarack Rich Swamp
Thuja occidentalis - (*Picea mariana*, *Abies balsamea*) / *Alnus incana* Forest Association (CEGL002456)	
FCS	White-cedar - (Mixed Conifer) / Alder Swamp
2. SHRUBLAND & GRASSLAND CLASS	
2.C.1.Nc. (D024.) Eastern North American Grassland, Meadow & Shrubland Division	
M163. Eastern North American Prairie & Barrens Macrogroup	
G063. Northern & Central Sand Barrens Group	
Pteridium aquilinum - *Bromus kalmii* Herbaceous Vegetation Association (CEGL005142)	
HBF	Bracken Grassland
M123. Eastern North American Ruderal Shrubland & Grassland Macrogroup	
G059. Northern & Central Ruderal Meadow & Shrubland Group	
SCX	Conifer Ruderal Shrubland
SDX	Deciduous Ruderal Shrubland
SMX	Conifer - Deciduous Ruderal Shrubland
HMX	Ruderal Grassland
2.C.3.Na. (D026.) Eastern North American Dune & Coastal Grassland & Shrubland Division	
M176. Eastern North American Beach, Shoreline & Flat Macrogroup	
G342. Eastern North American Lake Flat & Beach Group	
Inland Freshwater Strand Beach Sparse Vegetation Association (CEGL002310)	
VAV	Inland Freshwater Strand Beach

Map-class Code	Map-class Name
	M057. Eastern North American Coastal Grassland & Shrubland Macrogroup
	G089. Great Lakes Dune Grassland & Shrubland Group
	Ammophila breviligulata - (*Schizachyrium scoparium*) Herbaceous Vegetation (CEGL005098)
HAB	Great Lakes Beachgrass Dune
	Cakile edentula Great Lakes Shore Sparse Vegetation Association (CEGL005162)
VBO	Great Lakes Beach (blowout phase)
VES	Great Lakes Beach (erodable sand bank phase)
	Dasiphora fruticosa ssp. *floribunda* / *Cladium mariscoides* - *Juncus balticus* - (*Rhynchospora capillacea*) Herbaceous Vegetation Association (CEGL005105)
HDW	Interdunal Wetland
	Juniperus horizontalis - *Arctostaphylos uva-ursi* - *Juniperus communis* Dune Dwarf-shrubland Association (CEGL005064)
DJD	Great Lakes Juniper Dune Shrubland
	Pinus banksiana - (*Pinus resinosa*) - *Pinus strobus* / *Juniperus horizontalis* Wooded Herbaceous Vegetation Association (CEGL005125)
HPB	Great Lakes Coast Pine Barrens (barrens phase)
HPW	Great Lakes Coast Pine Barrens (woodland phase)
	Populus deltoides Woodland Alliance (A.1493)
WPB	Eastern Cottonwood Woodland (paper birch variant)
	Populus deltoides - (*Juniperus virginiana*) Dune Woodland Association (CEGL005119)
WCD	Cottonwood Dune Open Woodland
	Prunus pumila - (*Ptelea trifoliata*) Dune Shrubland Association (CEGL005075)
SCW	Sand Cherry Dune Shrubland
	2.C.4.Na. (D029.) North American Bog & Fen Division
	M062. North American Boreal Bog & Fen Macrogroup
	G386. Eastern North American Boreal Acidic Bog & Poor Fen Group
	Chamaedaphne calyculata / *Carex oligosperma* / *Sphagnum* spp. Poor Fen Dwarf-shrubland Association (CEGL005277)
DLF	Leatherleaf Poor Fen
	G185. Eastern North American Boreal Alkaline Fen Group
	Calamagrostis canadensis - *Carex viridula* - *Cladium mariscoides* - *Lobelia kalmii* Herbaceous Vegetation Association (CEGL005115)
HSM	Great Lakes Sedge Rich Shore Fen
	Carex lasiocarpa - (*Carex rostrata*) - *Equisetum fluviatile* Herbaceous Vegetation Association (CEGL005229)
HSS	Woolly-fruit Sedge Shore Fen
	Chamaedaphne calyculata - *Myrica gale* / *Carex lasiocarpa* Dwarf-shrubland Association (CEGL005228)
DLS	Leatherleaf - Sweetgale Shore Fen
	Dasiphora fruticosa ssp. *floribunda* - *Myrica gale* Rich Shore Fen Shrubland Association (CEGL005275)
SSF	Shrubby-cinquefoil - Sweetgale Rich Shore Fen

Map-class Code	Map-class Name
2.C.5.Na. (D030.) Eastern North American Freshwater Wet Meadow, Riparian & Marsh Division	
M067. Atlantic & Gulf Coastal Plain Pondshore & Wet Meadow Macrogroup	
G111. Atlantic & Gulf Coastal Plain Pondshore & Wet Prairie Group	
Rhynchospora capitellata - *Rhexia virginica* - *Rhynchospora scirpoides* - *Schoenoplectus hallii* Herbaceous Vegetation Association (CEGL005108)	
HCP	Inland Coastal Plain Marsh
M303. Eastern North American Ruderal Wet Meadow & Marsh Macrogroup	
G556. Northern & Central Ruderal Wet Meadow & Marsh Group	
Phragmites australis Eastern North America Temperate Semi-natural Herbaceous Vegetation Association (CEGL004141)	
HPG	Eastern Reed Marsh
M069. Eastern North American Wet Meadow & Marsh Macrogroup	
G125. Eastern North American Freshwater Marsh Group	
Schoenoplectus acutus - *Schoenoplectus subterminalis* - *Eleocharis palustris* - (*Schoenoplectus americanus*) Northern Great Lakes Shore Herbaceous Vegetation Association (CEGL005274)	
HEM	Northern Great Lakes Emergent Marsh
Typha spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation Association (CEGL002229)	
HCM	Midwest Mixed Emergent Deep Marsh
G112. Eastern North American Wet Meadow Group	
HWM	Wet Meadow Mixed Herbaceous
Calamagrostis canadensis - *Eupatorium maculatum* Herbaceous Vegetation Association (CEGL005174)	
HCC	Bluejoint Wet Meadow
Carex (*rostrata*, *utriculata*) - *Carex lacustris* - (*Carex vesicaria*) Herbaceous Vegetation Association (CEGL002257)	
HSG	Northern Sedge Wet Meadow
Carex stricta - *Carex* spp. Herbaceous Vegetation Association (CEGL002258)	
HUS	Upright Sedge Wet Meadow
Cornus sericea - *Salix* spp. - (*Rosa palustris*) Shrubland Association (CEGL002186)	
SDW	Dogwood - Willow Swamp (dogwood - willow phase)
SBC	Dogwood - Willow Swamp (black chokecherry phase)
5. AQUATIC VEGETATION CLASS	
5.B.1.Na. (D049.) North American Freshwater Aquatic Vegetation Division	
M108. Eastern North American Freshwater Aquatic Vegetation Macrogroup	
G114. Eastern North American Freshwater Aquatic Vegetation Group	
Nymphaea odorata - *Nuphar* (*microphylla*, *variegata*) Herbaceous Vegetation Association (CEGL002562)	
HFA	Northern Water-lily Aquatic Wetland
Potamogeton spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation Association (CEGL002282)	
HSV	Midwest Pondweed Submerged Aquatic Wetland

Map-class Code	Map-class Name
7. AGRICULTURAL VEGETATION CULTURAL CLASS	
Woody Agricultural Vegetation Subclass (L2)	
Woody Horticultural Crop Formation (L3)	
Orchard (tree) Subformation (L4)	
Fruit - Orchards Subgroup (L6)	
FOD	Deciduous Orchard
Herbaceous Agricultural Vegetation Subclass (L2)	
Cultivated Crop Formation (L3)	
HCF	Crop Field
Pasture / Hay Formation (L3)	
Permanent Pasture & Hayland Subformation (L4)	
HPF	Pasture Field
8. DEVELOPED VEGETATION CULTURAL CLASS	
Herbaceous & Woody Developed Vegetation Cultural Subclass (L2)	
Other Developed Urban / Built Up Vegetation Formation (L3)	
Developed Area (NLCD 2001; 21-24)	
CDV	Developed Area
NON-NVCS UNITS	
Non-Vegetated Water & Land (<1% vegetated)	
Non-Vegetated Water	
Open Water (NLCD 2001; 11)	
NSR	Stream & River
NWP	Open Water Pond
NWL	Open Water Lake
Non-Vegetated Land	
Barren Land (NLCD 2001; 31)	
NSB	Sand & Cobble Beach

Beech - Maple - Northern Hardwoods Forest (FBM)

The Beech - Maple - Northern Hardwoods Forest (FBM) map class represents the *Acer saccharum - Fagus grandifolia - Betula* spp. / *Maianthemum canadense* Forest Association (CEGL005004) in the NVCS. This map class captures a matrix hardwood forest of SLBE found throughout much of the landscape. The FBM was mapped extensively on the Manitou Islands (North and South), making up over three-quarters of the area on North Manitou Island and almost half of the area on South Manitou Island. On the mainland, the FBM was mapped more extensively further inland from Lake Michigan, beyond the sand dunes and the sand ridge-and-swale formations, and is more integrated with other hardwood forest types. The RD of conifers to hardwoods is <25%.

As a matrix forest, sugar maple and American beech are the diagnostic trees, with common associates of northern red oak, white ash, yellow birch, American basswood, and red maple. Because the FBM shares some similar environments with other hardwood forest types, it easily transitions toward and closely resembles those forest types that are captured by other map classes. Map classes most resembling FBM are the Sugar Maple - Ash - Basswood Northern Rich Mesic Forest (FMA) and the Northern Red Oak - Sugar Maple Forest (FOM). These two other map classes are dominant with sugar maple as well, yet all three of these map classes (FBM, FMA, and FOM) differ in the amounts of various hardwood tree species included.

To map FBM and FMA, much of the driving determination was the RD of beech to white ash and/or basswood. When the RD of beech to other hardwoods was >20%, the FBM map class was considered; however, when the RD of ash and/or basswood to other hardwoods was >20%, the FMA map class was considered, but only if the RD of beech to other hardwoods was <20%. (Typically, white ash is not a significant component of the FBM, yet when it was, and even when the RD of ash to other hardwoods was >20%, the FBM map class was used when the RD of beech to other hardwoods was >20%.) When the RD of beech to other hardwoods was <20% and the RD of ash and/or basswood was <20%, then the FBM map class was to be the default consideration. It is noteworthy that although FMA can be found further interior to the mainland and on the Manitou Islands (North and South), it is considered more a hardwood forest near the sandy bluffs along the Lake Michigan shores. The FMA is dryer and is more diverse in vegetation than is the FBM.

Much of the driving determination in mapping FOM was the RD of northern red oak and white oak to other hardwoods. When the RD of red oak and white oak to other hardwoods was >40%, the FOM map class was considered, even when the RD of beech to other hardwoods was >20%. When the RD of oaks to other hardwoods was <40%, the FOM map class was still considered when the RD of oaks to other hardwoods was >25%; however, this consideration was only in place when the forest consisted of ash and oaks with no other hardwoods present, even when ash was dominant to the oaks. Otherwise, the FBM or FMA map classes were considered, according to the convention provided above.

For AA, the FBM and FMA map classes were assessed together. Initial AA results showed confusion between these two map classes, and thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer.





Conifer Plantation (FPE)

The Conifer Plantation (FPE) map class represents the Northern & Central Conifer & Hardwood Plantation Group (G032) in the NVCS. The FPE map class captures conifers that have been planted, consisting of any conifer species, most commonly red pine.

Because of the cultivated disposition of being a plantation, the FPE map class was not assessed for accuracy.







Conifer Ruderal Forest (FCX)

The Conifer Ruderal Forest (FCX) map class represents, in part, the Northern & Central Hardwood & Conifer Ruderal Forest Group (G030) in the NVCS. Because of disturbance from human activity and the inherent variability of floristic vegetation in these early successional forests, a floristic type could not be determined. This map class captures ruderal forests usually resulting from past human disturbance (e.g., old field), with >25% tree cover and wherein the RD of conifers to hardwoods is >75%. Conifers consist of tree species both common and unique to the SLBE area. These ruderal forests can be with an open or closed canopy.

When the mutual RD of conifers and hardwoods was >25%, the Conifer - Hardwood Ruderal Forest (FMX) map class, which also represents (in part) the Northern & Central Hardwood & Conifer Ruderal Forest Group (G030), was considered. Also, when tree cover was <25% and shrub cover was >25%, the Conifer Ruderal Shrubland (SCX) map class was considered when the RD of conifers to deciduous shrubs was >75%. The Conifer - Deciduous Ruderal Shrubland (SMX) was considered when the mutual RD of deciduous and conifer shrubs was >25%. Furthermore, when tree cover and shrub cover were both <25%, the Ruderal Grassland (HMX) map class was considered.

Because of the disturbance regime inherent to ruderal forests, the FCX map class was not assessed for accuracy.



Hardwood Ruderal Forest (FDX and FBX)

The Hardwood Ruderal Forest map class represents, in part, the Northern & Central Hardwood & Conifer Ruderal Forest Group (G030) in the NVCS. Because of disturbance from human activity and the inherent variability of floristic vegetation in these early successional forests, a floristic type could not be determined. This map class captures ruderal forests usually resulting from past human disturbance (e.g., old field), with >25% tree cover and wherein the RD of hardwoods to conifers is >75%. Hardwoods consist of deciduous tree species both common and unique to the SLBE area. These ruderal forests can be with an open or closed canopy. This map class consists of two phases, including hardwood mix (FDX) and black locust (FBX).

When the mutual RD of conifers and hardwoods was >25%, the Conifer - Hardwood Ruderal Forest (FMX) map class, which also represents (in part) the Northern & Central Hardwood & Conifer Ruderal Forest Group (G030), was considered. Also, when tree cover was <25% and shrub cover was >25%, the Conifer - Deciduous Ruderal Shrubland (SMX) map class was considered when the mutual RD of deciduous and conifer shrubs was >25%. When the RD of conifer to deciduous shrubs was >75%, then the Conifer Ruderal Shrubland (SCX) map class was considered. Furthermore, when tree cover and shrub cover were both <25%, the Ruderal Grassland (HMX) map class was considered.

The hardwood mix (FDX) phase captures forests consisting of any mixture of hardwoods other than a more monotypic stand of black locust. The black locust (FBX) phase captures forests consisting of monotypic (or near monotypic) stands of black locust. The FBX map class was added because of interest to park management activities.

Because of the disturbance regime inherent to ruderal forests, the Hardwood Ruderal Forest map class was not assessed for accuracy.

Hardwood Ruderal Forest (hardwood mix phase)–FDX

The hardwood mix (FDX) map-class phase represents the Hardwood Ruderal Forest map class (as described above). This phase captures forests consisting of any mixture of hardwoods other than a monotypic (or near monotypic) stand of black locust. Stands of FDX are by far more common than stands of the black locust (FBX) map-class phase of this same map class.





Hardwood Ruderal Forest (black locust phase)–FBX

The black locust (FBX) map-class phase represents the Hardwood Ruderal Forest map class (as described above). This phase captures forests consisting of monotypic (or near monotypic) stands of black locust. Stands of FBX are by far less common than stands of the hardwood mix (FDX) map-class phase of this same map class.

No representative pictures are available.

Conifer - Hardwood Ruderal Forest (FMX)

The Conifer - Hardwood Ruderal Forest (FMX) map class represents, in part, the Northern & Central Hardwood & Conifer Ruderal Forest Group (G030) in the NVCS. Because of disturbance from human activity and the inherent variability of floristic vegetation in these early successional forests, a floristic type could not be determined. This map class captures ruderal forests usually resulting from past human disturbance (e.g., old field), having >25% tree cover and wherein the mutual RD of conifers and hardwoods is >25%. Conifers and hardwoods consist of tree species both common and unique to the SLBE area. These ruderal forests can be with an open or closed canopy.

When the RD of conifers to hardwoods was >75%, the Conifer Ruderal Forest (FCX) map class, which also represents (in part) the Northern & Central Hardwood & Conifer Ruderal Forest Group (G030) class, was considered. Likewise, when the RD of hardwoods to conifers was >75%, the hardwood mix (FDX) map-class phase of the Hardwood Ruderal Forest map class, which also represents (in part) the Northern & Central Hardwood & Conifer Ruderal Forest Group (G030), was considered. Also, when tree cover was <25% and shrub was cover >25%, the Conifer - Deciduous Ruderal Shrubland (SMX) was considered when the mutual RD of deciduous and conifer shrubs was >25%. Furthermore, when tree cover and shrub cover were both <25%, the Ruderal Grassland (HMX) map class was considered.

Because of the disturbance regime inherent to ruderal forests, the FMX map class was not assessed for accuracy.



Great Lakes Dune Pine Forest (FPD)

The Great Lakes Dune Pine Forest (FPD) map class represents the *Pinus banksiana - Pinus resinosa - Pinus strobus* Dune Forest Association (CEGL002589) in the NVCS. This map class captures dry forests wherein there is a mixture of red pine, eastern white pine, and/or jack pine and wherein tree canopy contributes >60% cover. These forests are located in the interdunal zones of active sand dunes of SLBE. The Great Lakes Coast Pine Barrens map class, consisting of two map-class phases (the barrens [HPB] and the woodland [HPW]), captures similar stands wherein tree canopy contributes <60% cover and is typically of jack pine rather than a mix of pine species. The understory vegetation in FPD includes typical sand dunal species, such as American beachgrass, sandcherry, common juniper, creeping juniper, and kinnikinnick, but not lowbush blueberry. The RD of the hardwood tree component to conifer trees is <30%.

When pine-dominant forests were more inland from active sand dunes, particularly when understory vegetation common to sand dunes became less common and was replaced with low-bush blueberry shrubs, then other pine-dominant map classes were considered, including White Pine / Blueberry Dry-Mesic Forest (FWP), Jack Pine / Blueberry / Feathermoss Forest (FJB), and Red Pine / Blueberry Dry Forest (FRP), depending on the RDs of pines.

When on these active sand dunes and when the RD of northern white-cedar and balsam fir to pines was >40% in the upper canopy, the conifer (FCC) phase of the White-cedar - Boreal Conifer Mesic Forest map class was considered, unless the mutual RD of white-cedar and hardwoods was >25%, in which instances the maple coastal dune (FCM) phase of the same map class was considered.

For AA, the FPD map class was assessed independently of all other map classes.



Jack Pine - Northern Pin Oak Forest (FJO)

The Jack Pine - Northern Pin Oak Forest (FJO) map class represents the *Pinus banksiana* - (*Pinus resinosa*) - *Quercus ellipsoidalis* / *Carex pensylvanica* Forest Association (CEGL002478) in the NVCS. This map class captures dry, open forests on sandy ridges of dune ridge-and-swale complexes; these forests are dominated by jack pine and northern red oak and/or black oak with some white oak, even when oak trees are scrub and subcanopy. These forests are most commonly mapped within the sand ridge-and-swale complex of the Platte Bay area between the Platte River and Otter River. The mutual RD of conifers and hardwoods is >25%, with a RD of jack pine to eastern white pine and red pine of >50%, yet with a RD of white pine to all pines of <25%.

When the RD of hardwoods to conifers was >25% and when the RD of eastern white pine to all pines was >25%, either the White Pine - Red Oak Forest (FWO) map class or the White Pine - Aspen - Birch Forest (FWA) map class was considered, depending on the RD of various hardwood species to each other (e.g., oaks, bigtooth aspen, red maple).

The FJO is in proximity, both in concept and in location, with the Jack Pine / Blueberry / Feathermoss Forest (FJB) class. When the RD of oaks and other hardwoods to jack pine was <25% and blueberry shrubs were more prominent, the FJB map class was considered.

For AA, the FJO map class was assessed independently of all other map classes.





Red Pine - Aspen - Birch Forest (FRA)

The Red Pine - Aspen - Birch Forest (FRA) map class represents the *Pinus resinosa* - *Populus tremuloides* / *Diervilla lonicera* - *Vaccinium* spp. Forest Association (CEGL002520) in the NVCS. This map class captures dry-mesic forests of mixed conifer and hardwood common to sandplains wherein the RD of red pine to other conifers (particularly, white pine and jack pine) is >75%. The RD of hardwood trees (consisting of varying amounts of red maple, aspen, paper birch, and green ash, with northern red oak and white oak less than dominant) to conifer trees is >25%. Noteworthy, when red oak became dominant to other hardwoods (the RD of red oak and white oak to other hardwoods was >50%), the White Pine - Red Oak Forest (FWO) map class was considered, regardless of the RD of white pine to other pines being <25%.

When the RD of hardwoods to conifers was >75%, either the Beech - Maple - Northern Hardwoods Forest (FBM) map class, Sugar Maple - Ash - Basswood Northern Rich Mesic Forest (FMA) map class, or the Aspen - Birch - Red Maple Forest (FBR) map class was likely considered, depending on the RD of hardwood tree components to each other. Conversely, when the RD of hardwoods to conifer trees was <25%, other map classes were considered as follows: (1) when the RD of red pine to other conifers was >75%, the Red Pine / Blueberry Dry Forest (FRP) map class was considered, and (2) when the RD of red pine to other conifers was <75%, other mixed conifer-hardwood map classes were considered, such as White Pine - Aspen - Birch Forest (FWA).

For AA, the FRA, FRP, FWA, and White Pine / Blueberry Dry-Mesic Forest (FWP) map classes were assessed together. Initial AA results showed confusion between these four map classes, and thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer.





Red Pine / Blueberry Dry Forest (FRP)

The Red Pine / Blueberry Dry Forest (FRP) map class represents the *Pinus resinosa* / *Vaccinium* spp. Forest Association (CEGL002443) of the NVCS. This map class captures dry to dry-mesic forests common to sandplains wherein red pine is strongly dominant. The RD of red pine to other conifers is >75% (>50% RD when on sand dunes), and the RD of hardwoods to conifers is <25%. Sites of FRP are often in proximity to White Pine / Blueberry Dry-Mesic Forest (FWP), yet FRP sites are found at slightly dryer sites. The understory shrubs are typical with lowbush blueberry and velvetleaf huckleberry. Planted red pine stands are captured with the Conifer Plantation (FPE) map class.

When the RD of hardwoods to conifers was >25%, with a RD of red pine to other conifers of >75%, the Red Pine - Aspen - Birch Forest (FRA) map class was considered. The exception to this strategy was when the RD of red oak and white oak to other hardwoods was >50%, in which cases the White Pine - Red Oak Forest (FWO) map class was considered (even when the RD of eastern white pine to other pines was <25%). Furthermore, when the RD of red pine to all conifers was <75%, then other conifer forest map classes were considered as follows: (1) when the RD of eastern white pine to red pine and jack pine was >25%, the White Pine / Blueberry Dry-Mesic Forest (FWP) map class was considered, and (2) when jack pine was dominant, the Jack Pine / Blueberry / Feathermoss Forest (FJB) map class was considered.

When stands of red pine were on active sand dunes, having an understory layer of typical sand dunal vegetation, including American beachgrass, sandcherry, common juniper, kinnikinnick, and woolly beach-heather (but lacking blueberry), then the Great Lakes Dune Pine Forest (FPD) map class was considered when tree canopy was >60% cover, and either the barrens (HPB) phase or the woodland (HPW) phase of the Great Lakes Coast Pine Barrens map class was considered when tree canopy was <60% cover.

For AA, the FRP, FRA, FWP, and White Pine - Aspen - Birch Forest (FWA) map classes were assessed together. Initial AA results showed confusion between these four map classes, and thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer.





White Pine - Red Oak Forest (FWO)

The White Pine - Red Oak Forest (FWO) map class represents the *Pinus strobus* - (*Pinus resinosa*) - *Quercus rubra* Forest Association (CEGL002480) of the NVCS. This map class captures mesic to dry-mesic forests of eastern white pine-hardwood on sandplains wherein northern red oak (with some white oak) is the dominant hardwood tree (the RD of red oak and white oak to other hardwoods being >50%). Other hardwood trees present may consist of aspen, paper birch, and the mutual RD of conifers and hardwoods is >25%, with a RD of white pine to conifers of >25%. Red pine often complements white pine, more often in dry-mesic settings. Even when the RD of white pine to other pines (namely red pine) was <25%, the FWO map class was considered because of the dominance of red oak and white oak to other hardwoods. White pine can form a supracanopy above the hardwoods or can be subcanopy to the hardwoods.

When the RD of hardwoods to conifers was <25%, and the RD of white pine to all other conifers was >25%, the White Pine / Blueberry Dry-Mesic Forest (FWP) map class was considered. Conversely, when the RD of hardwoods to conifers was >75%, with the RD of red oak and white oak to other hardwoods being >40% (sometimes as low as 25%), the Northern Red Oak - Sugar Maple Forest (FOM) map class was considered.

Also, when red oak and white oak were less than dominant to other hardwoods such as red maple, bigtooth aspen, paper birch, and other hardwoods, the White Pine - Aspen - Birch Forest (FWA) map class was considered. Additionally, when the RD of white pine to other pines was <25% and the RD of jack pine to other pines was >25%, the Jack Pine - Northern Pin Oak Forest (FJO) map class was considered.

For AA, the FWO map class was assessed independently of all other map classes.





White Pine - Aspen - Birch Forest (FWA)

The White Pine - Aspen - Birch Forest (FWA) map class represents the *Pinus strobus - Populus tremuloides* / *Corylus cornuta* Forest Association (CEGL002479) in the NVCS. This map class captures mesic to dry-mesic forests of mixed conifer and hardwood wherein the RD of eastern white pine to other conifers is >25%. The RD of hardwoods to conifers is >25%. Typical hardwoods consist of varying amounts of red maple, bigtooth aspen, paper birch, sugar maple, green ash, white ash, American basswood, American beech, yellow birch, and oaks. Northern red oak and white oak are less than dominant to other hardwoods. White pine often forms a supracanopy above the hardwood forest canopy. A significant amount of red pine can be present, particularly in the dry-mesic sites. FWA forests often include an element of balsam fir, white spruce, and northern white-cedar.

When the RD of hardwoods to conifers was <25%, the White Pine / Blueberry Dry-Mesic Forest (FWP) map class was considered. When the RD of red oak and white oak to other hardwoods was >50%, the White Pine - Red Oak Forest (FWO) map class was considered. Likewise, when the RD of red pine to other conifers was >75%, the Red Pine - Aspen - Birch Forest (FRA) map class was considered, unless red oak (with white oak) dominated the hardwoods component, in which cases the FWO map class was still considered, regardless of the RD of white pine to other pines being <25%. Conversely, when the RD of hardwoods to conifers was >75%, either the Beech - Maple - Northern Hardwoods Forest (FBM) map class, Sugar Maple - Ash - Basswood Northern Rich Mesic Forest (FMA) map class, or the Aspen - Birch - Red Maple Forest (FBR) map class was likely considered, depending on the RD of hardwood tree components to each other; however, if the RD of red oak and white oak to other hardwoods was >40% (sometimes as low as 25%), the Northern Red Oak - Sugar Maple Forest (FOM) map class was considered.

For AA, the FWA, FWP, FRA, and Red Pine / Blueberry Dry Forest (FRP) map classes were assessed together. Initial AA results showed confusion between these four map classes, and thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer.





White Pine / Blueberry Dry-Mesic Forest (FWP)

The White Pine / Blueberry Dry-Mesic Forest (FWP) map class represents the *Pinus strobus* / *Vaccinium* spp. Forest Association (CEGL002444) NVCS. This map class captures dry-mesic to dry forests of eastern white pine located on sandplains. The FWP can have either an open or a closed canopy and lack a tall-shrub understory. A significant amount of red pine can be present. The RD of hardwoods to conifers is <25%, and the RD of white pine to all conifers (particularly other pines) is >25%; however, when on sand dunes, the RD of white pine to all conifer trees is >50%. Planted white pine stands are captured with the Conifer Plantation (FPE) map class.

When the RD of white pine to red pine and/or jack pine was <25% and when the RD of red pine to all other conifers was > 75%, the Red Pine / Blueberry Dry Forest (FRP) map class was considered; however, when the RD of jack pine to all other conifers was >25%, the Jack Pine / Blueberry / Feathermoss Forest (FJB) map class was considered. Furthermore, when the RD of hardwoods to conifers was >25%, the White Pine - Aspen - Birch Forest (FWA) map class was considered, unless the RD of northern red oak (with white oak) to other hardwoods was >50%, in which cases the White Pine - Red Oak Forest (FWO) map class was considered.

When stands of white pine were on active sand dunes, having an understory layer of typical sand dunal vegetation, including American beachgrass, sandcherry, common juniper, kinnikinnick, and woolly beach-heather (but lacking blueberry), then the Great Lakes Dune Pine Forest (FPD) map class was considered when tree canopy was >60% cover, and either the barrens (HPB) phase or the woodland (HPW) phase of the Great Lakes Coast Pine Barrens map class was considered when tree canopy was <60% cover.

For AA, the FWP, FWA, FRP, Red Pine - Aspen - Birch Forest (FRA) map classes were assessed together. Initial AA results showed confusion between these four map classes, and thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer.





Sugar Maple - Ash - Basswood Northern Rich Mesic Forest (FMA)

The Sugar Maple - Ash - Basswood Northern Rich Mesic Forest (FMA) map class represents the *Acer saccharum - Fraxinus americana - Tilia americana* / *Acer spicatum* / *Caulophyllum thalictroides* Forest Association (CEGL005008) in the NVCS. This map class captures a hardwood forest type that is similar to the Beech - Maple - Northern Hardwoods Forest (FBM) map class, which is a matrix forest type at SLBE. Although FMA can be found interior to the mainland and on the Manitou Islands (North and South), it is more often considered a hardwood forest that occurs near the sandy bluffs along the Lake Michigan shores. The FMA is dryer and is less diverse in vegetation than is the FBM. The RD of conifers to hardwoods is <25%.

To map FMA and FBM, much of the driving determination was the RD of white ash and/or basswood to beech. When the RD of ash and/or basswood to other hardwoods was >20%, the FMA map class was considered, but only if the RD of beech to other hardwoods was <20%; however, when the RD of beech to other hardwoods was >20%, the FBM map class was still considered. (Typically, white ash is not a significant component of the FBM, yet when it was, and even when the RD of ash to other hardwoods was >20%, the FBM map class was used when the RD of beech to other hardwoods was >20%.) When the RD of beech to other hardwoods was <20% and the RD of ash and/or basswood was <20%, then the FBM map class was the default consideration.

Furthermore, when the RD of northern red oak and white oak to other hardwoods was >40%, the FOM map class was considered. Also, when the RD of oaks to other hardwoods was <40%, the FOM map class was still considered when the RD of oaks to other hardwoods was >25%; however, this consideration was only held when the forest consisted of ash and oaks with no other hardwoods present, even when ash was dominant to the oaks. Otherwise, the FBM or FMA map classes were considered, according to the convention provided above.

For AA, the FBM and FMA map classes were assessed together. Initial AA results showed confusion between these two map classes, and thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer.





Aspen - Birch - Red Maple Forest (FBR)

The Aspen - Birch - Red Maple Forest (FBR) map class represents the *Populus tremuloides* - *Betula papyrifera* - (*Acer rubrum, Populus grandidentata*) Forest Association (CEGL002467) in the NVCS. This map class captures mesic to dry-mesic forests of mixed hardwood trees consisting of aspens, paper birch, and/or red maple, in which the RD of these combined to other hardwoods is >75%. The RD of conifers to hardwoods is <25%. Sugar maple, yellow birch, northern red oak, American beech, and American basswood are minor components.

When the combined RD of aspens, paper birch, and red maple to other hardwoods was <75%, then other hardwood forest map classes were considered, including Beech - Maple - Northern Hardwoods Forest (FBM) and Northern Red Oak - Sugar Maple Forest (FOM).

Within the FBR class, pine trees can have a scattered occurrence; however, when the RD of pines to aspens, paper birch, red maple, and other associated hardwoods was >25%, a pine-deciduous map class was considered. When the mutual RD of conifers and hardwoods was >25% and when the RD of eastern white pine to other conifers was >25%, the White Pine - Aspen - Birch Forest (FWA) map class was considered. Likewise, when the RD of red pine to other conifers was >75%, the Red Pine - Aspen - Birch Forest (FRA) map class was considered.

Similarly, when the mutual RD of conifers and hardwoods was >25%, yet the RD of pines to other conifers was <25%, the yellow birch interior (FCB) phase of the White-cedar - Boreal Conifer Mesic Forest map class or the Spruce - Fir - Aspen Forest (FCP) map class was considered, depending on the RDs of conifer species to each other.

For AA, the FBR map class was assessed independently of all other map classes.





Northern Red Oak - Sugar Maple Forest (FOM)

The Northern Red Oak - Sugar Maple Forest (FOM) map class represents the *Quercus rubra* - *Acer saccharum* - (*Betula alleghaniensis*) Forest Association (CEGL002461) in the NVCS. This map class captures dry-mesic to mesic forests wherein the RD of northern red oak and white oak to other hardwoods is >40%; however, the RD of oaks to other hardwoods can be as low as 25% when the forest consists of white ash and oaks with no other hardwoods present, even when ash is dominant to the oaks. The RD of conifers to hardwoods is <25%.

When the RD of red oak and white oak to other hardwoods did not meet the above criteria, other hardwood forest map classes were considered, including Beech - Maple - Northern Hardwoods Forest (FBM) and Sugar Maple - Ash - Basswood Northern Rich Mesic Forest (FMA). (Note that the FOM map class was still considered even when the RD of American beech to all other hardwoods was >20%. Typically, with this significant amount of beech present, the FBM map class would be considered). When the RD of conifers to hardwoods was >25%, other conifer-hardwood map classes were considered, depending on the RD of pine species to each other. Alternative classes that were considered included Jack Pine - Northern Pin Oak Forest (FJO), even though in that map class the oaks consist primarily of red oak and/or black oak with some white oak, and White Pine - Red Oak Forest (FWO).

For AA, the FOM map class was assessed independently of all other map classes.





White-cedar - Boreal Conifer Mesic Forest (FCC, FCB, and FCM)

The White-cedar - Boreal Conifer Mesic Forest map class represents the *Thuja occidentalis* / *Abies balsamea - Acer spicatum* Forest Association (CEGL002449) in the NVCS. This map class consists of three phases, including conifer (FCC), yellow birch interior (FCB), and maple coastal dune (FCM). The White-cedar - Boreal Conifer Mesic Forest map class captures wet-mesic to dry-mesic forests wherein the RD of northern white-cedar and other mixed conifers to hardwoods is >25%. The conifer trees can be short and subcanopy to the hardwoods. The RD of white-cedar to balsam fir and white spruce is >25% and to eastern hemlock is >50%; however, balsam fir can be a primary component. When on sand dunes and foredunes, the RD of white-cedar and balsam fir is >40% in the upper canopy. Depending on location, hardwoods typically consist of yellow birch and/or red maple, with elements of paper birch and may even include some American basswood and sugar maple in foredune locations. Eastern white pine can be scattered, but the RD of white pine to all conifer trees should be <25%.

When the RD of conifers to hardwoods was <25%, other hardwood forest map classes were considered, including Beech - Maple - Northern Hardwoods Forest (FBM), Sugar Maple - Ash - Basswood Northern Rich Mesic Forest (FMA), and Aspen - Birch - Red Maple Forest (FBR). When the RD of eastern hemlock to white-cedar was >50% and the RD of hardwoods to conifers was <25%, the Hemlock Mesic Forest (FHC) map class was considered. When the RD of hardwoods to conifers was >25%, the Great Lakes Hemlock - Beech - Hardwood Forest (FHB) map class was considered.

For vegetation occurring in sand dune and foredune sites wherein the RD of white-cedar and balsam fir to pines (white, jack, and red) was <40% in the upper canopy, other pine-dominant map classes were considered, including (yet not limited to) the barrens (HPB) and woodland (HPW) phases of the Great Lakes Coast Pine Barrens, and the Great Lakes Dune Pine Forest (FPD).

For vegetation occurring in wetland sites dominated by white-cedar, the White-cedar - (Mixed Conifer) / Alder Swamp (FCS) map class or the White-cedar - Black Ash Swamp (FCA) map class was considered, depending on the RDs of conifers and hardwoods to each other. Although the White-cedar - Boreal Conifer Mesic Forest can easily grade into the White-cedar - Boreal Conifer Mesic Forest, it lacks peatland swamp characteristics.

The conifer (FCC) phase captures mesic white-cedar forests wherein the RD of conifer trees (consisting primarily of white-cedar and balsam fir) to hardwood trees is >75%. The yellow birch interior (FCB) phase captures forests interior to and beyond the foredunes to Lake Michigan wherein the mutual RD of conifers and hardwoods is >25%. The dominant hardwood tree is typically yellow birch and/or paper birch. The maple coastal dune (FCM) phase captures forests on coastal foredunes above the shores of Lake Michigan. The dominant hardwood tree is typically a mix of sugar maple, red maple, and American basswood.

For AA, the three map-class phases (FCC, FCB, and FCM) were combined because they collectively represent one association type. They were left, however, as separate entities in the vegetation map layer.

White-cedar - Boreal Conifer Mesic Forest (conifer phase)–FCC

The conifer (FCC) map-class phase represents the White-cedar - Boreal Conifer Mesic Forest map class (as described above) when the RD of the conifer component to hardwoods is >75%. When the RD of hardwoods to conifers was >25%, the conifer - hardwood (FCM) phase of this same map class was considered. A significant amount of balsam fir and some white spruce may be present in the FCC phase, but their combined RD to northern white-cedar should be <75%. Eastern hemlock may also be present, but its RD to white-cedar should be <50%. Forests in the FCC phase are often dense, with a shaded understory and sparse vegetation ground layer. They are in mesic locations but not wetlands. The FCC is common on dune and foredune settings, receiving spray and fog influences from Lake Michigan. Prominent examples of FCC sites in this setting are located on the southwest shore of South Manitou. FCC sites also exist in interior locations further away from Lake Michigan.

When the mutual RD of conifers and hardwoods was >25%, then one of the other two map-class phases were considered. For sites of White-cedar - Boreal Conifer Mesic Forest occurring in interior locations further away from Lake Michigan, the yellow birch interior (FCB) phase of this same map class was considered, and when on coastal foredunes above the shores of Lake Michigan, the maple coastal dune (FCM) phase of this same map class was considered.









White-cedar - Boreal Conifer Mesic Forest (yellow birch interior phase)–FCB

The yellow birch interior (FCB) map-class phase represents the White-cedar - Boreal Conifer Mesic Forest map class (as described above) when the mutual RD of conifers and hardwoods is >25% and when forests are located interior from Lake Michigan, beyond the foredunes. When the RD of hardwoods to conifers was <25%, the conifer (FCC) phase of this same map class was considered. FCB-phase forests are often less dense and more open than FCC-phase forests and, thus, have richer understory vegetation. As with the FCC phase, a significant amount of balsam fir and some white spruce may be present in the FCB phase, but their combined RD to northern white-cedar should be <75%. Eastern hemlock may also be present in the FCB phase, but its RD to white-cedar should be <50%.

In the FCB phase, the hardwood trees consist primarily of yellow birch and paper birch, although yellow birch can be less prominent because of various natural or human events (e.g., wind throws and logging) and is often replaced with paper birch. The hardwood tree canopy typically covers and obscures the conifer trees. To determine the correct forest type during the mapping of the FCB phase, it was necessary to refer to aerial photographs obtained during spring, leaf-off conditions to determine not merely the conifer component, but also the RDs among conifer species (e.g., the RD of northern white-cedar to balsam fir or eastern hemlock).

For sites of White-cedar - Boreal Conifer Mesic Forest occurring on coastal foredunes along the shores of Lake Michigan, the maple coastal dune (FCM) phase of this same map class was considered.





White-cedar - Boreal Conifer Mesic Forest (maple coastal dune phase)–FCM

The maple coastal dune (FCM) map-class phase represents the White-cedar - Boreal Conifer Mesic Forest map class (as described above) when the mutual RD of conifers and hardwoods is >25% and when forests are located on the coastal foredunes above the shores of Lake Michigan. When the RD of hardwoods to conifers was <25%, the conifer (FCC) phase of this same map class was considered. In the FCM phase, yellow birch is less prominent than in the yellow birch interior (FCB) phase of this same map class; however, sugar maple, red maple, and even some American basswood are more characteristic of these sites. As with the FCC phase, a significant amount of balsam fir and some white spruce may be present in the FCM phase, but their combined RD to northern white-cedar should be <75%. Eastern hemlock is typically not a prominent component in the foredune locations of FCM.

For sites of White-cedar - Boreal Conifer Mesic Forest occurring interior, beyond foredune sites, the FCB phase of this same map class was considered.



Hemlock Mesic Forest (FHC)

The Hemlock Mesic Forest (FHC) map class represents the *Tsuga canadensis* - (*Betula alleghaniensis*) Forest Association (CEGL002598) in the NVCS. This map class captures mesic to wet-mesic conifer forests wherein the RD of eastern hemlock to northern white-cedar is >50%; the RD of eastern white pine to other conifers is <25%; and the RD of hardwoods to all conifers is <25%. When the RD of white-cedar to hemlock was >50%, the conifer (FCC) phase of the White-cedar - Boreal Conifer Mesic Forest map class was considered.

For FCH, the few hardwoods present might consist of American beech, sugar maple, paper birch, yellow birch, and red maple. When the collective RD of hardwoods to conifers was >25%, the Great Lakes Hemlock - Beech - Hardwood Forest (FHB) map class was considered. For vegetation in wetland sites dominated by hemlock, the Hemlock - Yellow Birch Swamp Wet-Mesic Forest (FHS) was considered.

For AA, the FHC map class was assessed independently of all other map classes.



Great Lakes Hemlock - Beech - Hardwood Forest (FHB)

The Great Lakes Hemlock - Beech - Hardwood Forest (FHB) map class represents the *Tsuga canadensis - Fagus grandifolia* - (*Acer saccharum*) Great Lakes Forest Association (CEGL005042) in the NVCS. This map class captures mesic to wet-mesic forests of conifers and hardwoods wherein the RD of eastern hemlock to northern white-cedar is >50%; the RD of eastern white pine to other conifers is <25%; and the mutual RD of hardwoods and conifers is >25%. The hardwoods consist mostly of American beech and sugar maple, along with elements of red maple, white ash, paper birch, yellow birch, bigtooth aspen, northern red oak, and American basswood. When the collective RD of hardwoods to conifers was <25%, the Hemlock Mesic Forest (FHC) map class was considered.

When the RD of hardwoods to conifers was >75%, other hardwood forest map classes were considered, including the Beech - Maple - Northern Hardwoods Forest (FBM), Sugar Maple - Ash - Basswood Northern Rich Mesic Forest (FMA), and Northern Red Oak - Sugar Maple Forest (FOM) map classes. When the RD of white pine to conifers was >25%, the White Pine - Aspen - Birch Forest (FWA) map class was considered. When the RD of white-cedar to hemlock was >50%, the yellow birch interior (FCB) phase of the White-cedar - Boreal Conifer Mesic Forest map class was considered. Furthermore, for vegetation in wetland sites dominated by hemlock, the Hemlock - Yellow Birch Swamp Wet-Mesic Forest (FHS) was considered.

For AA, the FHB map class was assessed independently of all other map classes.





Red Maple - Ash - Birch Swamp Forest (FRM)

The Red Maple - Ash - Birch Swamp Forest (FRM) map class represents the *Acer rubrum* - *Fraxinus* spp. - *Betula papyrifera* / *Cornus canadensis* Forest Association (CEGL002071) in the NVCS. This map class typically captures wetland forests in response to changing hydrology from beaver activity. Hardwoods consist mostly of red maple, with yellow birch, paper birch, tamarack, and black ash commonly present. The RD of black ash to the other hardwoods is <50%. The FRM map class is often typified by tall red maple trees with an open canopy, but when in early succession, these swamp forests can include short-statured trees with a dense canopy. The understory of swamp forests with an open-canopy is often of bluejoint and sedges, with some element of shrubs; however, because of hydrology changes from beaver influence, floristic vegetation can be highly variable from one stand to another. Some northern white-cedar and eastern white pine may be present.

When the RD of black ash to all hardwoods was >50%, the Black Ash - Mixed Hardwood Swamp (FBA) map class was considered. When the RD of white-cedar to hardwoods (regardless of species) was >25%, the White-cedar - Black Ash Swamp (FCA) map class was considered. When hardwoods made up <25% canopy cover, then shrub and herbaceous map classes were considered, including Gray Alder Swamp Shrubland (SAS), Wet Meadow Mixed Herbaceous (HWM), Bluejoint Wet Meadow (HCC), and Northern Sedge Wet Meadow (HSG).

For AA, the FRM map class was assessed independently of all other map classes.





Black Ash - Mixed Hardwood Swamp (FBA)

The Black Ash - Mixed Hardwood Swamp (FBA) map class represents the *Fraxinus nigra* - Mixed Hardwoods - Conifers / *Cornus sericea* / *Carex* spp. Forest Association (CEGL002105) in the NVCS. This map class captures wet-mesic and swamp forests in basins and drainages wherein the RD of black ash to other hardwoods is >50%. Other hardwoods may consist of red maple, yellow birch, paper birch. Conifers present are often of short-statured trees and may consist of northern white-cedar, yet the RD of all conifers to hardwoods is <25%. (Balsam fir may be present in any amount.) The forest canopy can be open, with a significant understory of gray alder shrub. Typical settings range from wet-mesic drainages to margins of wetland basin.

When the RD of black ash to other hardwoods (with red maple being primary) was <50%, the Red Maple - Ash - Birch Swamp Forest (FRM) map class was considered; however, when hardwoods made up <25% canopy cover and alder shrubs made up >25% cover, the Gray Alder Swamp Shrubland (SAS) map class was considered. When the RD of conifers to hardwoods was >25% and the RD of white-cedar to conifers was >25%, the White-cedar - Black Ash Swamp (FCA) map class was considered.

For AA, the FBA, FCA, and White-cedar - (Mixed Conifer) / Alder Swamp (FCS) map classes were assessed together. Initial AA results showed confusion between these three map classes, and thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer. The confusion between these map classes were with FBA and FCA, FCA and FCS, but not FBA and FCS.





Central Tamarack Poor Swamp (FTS)

The Central Tamarack Poor Swamp (FTS) map class represents the *Larix laricina* / *Photinia melanocarpa* / *Sphagnum* spp. Forest Association (CEGL002472) of the NVCS. This map class captures minerotrophic-rich swamp forests wherein the RD of tamarack to northern white-cedar is >50% and the shrub understory is dominant with black chokeberry. Sphagnum and peatland ericads are lacking or only nominally present. The FTS is rare at SLBE and shares the same environment as the black chokecherry (SBC) phase of the Dogwood - Willow Swamp map class; the only two polygons of FTS that were mapped are in the Platte Bay Unit.

When understory shrubs are dominant with gray alder, the Northern Tamarack Rich Swamp (FTR) map class was considered. Both the FTR and FTS share the same environment.

For AA, the FTS map class was assessed independently of all other map classes.



White Pine - Red Maple Swamp (FWS)

The White Pine - Red Maple Swamp (FWS) map class represents the Pinus strobus - (*Acer rubrum*) / *Osmunda* spp. Forest Association (CEGL002482) in the NVCS. The FWS map class captures mixed conifer-hardwood swamp forests, consisting mostly of white pine and red maple, with yellow birch and paper birch commonly present; tamarack is absent. These swamps can be located on the ridge and dune sand formations or further inland on more organic soils. The mutual RD of conifers and hardwoods is >25%, and the RD of white pine to conifers and hardwoods (consisting most typically of red maple) is >25%. At least a thin organic layer is established with sphagnum, leatherleaf, and blueberry.

When the RD of black spruce and/or tamarack to all conifers was >25% and when peatland flora was well established, either the black spruce (FSS) phase or the tamarack (FTP) phase of the Black Spruce - Tamarack / Labrador-tea Poor Swamp map class was considered.

For AA, the FWS map class was assessed independently of all other map classes.





White-cedar - Black Ash Swamp (FCA)

The White-cedar - Black Ash Swamp (FCA) map class represents the *Thuja occidentalis* - *Fraxinus nigra* Forest Association (CEGL005165) in the NVCS. This map class captures mixed conifer and hardwood wetland forests wherein the mutual RD of conifers and hardwoods is >25%, the RD of northern white-cedar to other conifers is >25%, and the RD of black ash to other hardwoods is >25%; however, the black ash is sometimes diminished and the site is dominant with red maple and yellow birch. Typical settings range from wet-mesic drainages to wetland margins of basins. Red maple, yellow birch, paper birch, and balsam fir are common component trees, with gray alder a common shrub, particularly when forest canopy is open. The white-cedar can often be obscured by a slightly taller black ash canopy; therefore, the use of aerial photographs obtained during spring, leaf-off conditions was helpful in distinguishing FCA and Black Ash - Mixed Hardwood Swamp (FBA) during mapping.

When the RD of hardwoods to conifers was <25%, the White-cedar - (Mixed Conifer) / Alder Swamp (FCS) map class was considered. Likewise, when the RD of conifers to hardwoods was <25%, the FBA map class was considered. Also, within mesic-wet sites, when black ash diminished and was replaced with yellow birch and paper birch, the conifer - hardwood (FCM) phase of the White-cedar - Boreal Conifer Mesic Forest map class was considered.

For AA, the FCA, FBA, FCS map classes were assessed together. Initial AA results showed confusion between these three map classes, and thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer. The confusion between these map classes were with FBA and FCA, FCA and FCS, but not FBA and FCS.



Hemlock - Yellow Birch Swamp Wet-Mesic Forest (FHS)

The Hemlock - Yellow Birch Swamp Wet-Mesic Forest (FHS) represents the *Tsuga canadensis* - *Betula alleghaniensis* Saturated Forest Association (CEGL005003) in the NVCS. This map class captures eastern hemlock wetland seep forests wherein the RD of hemlock to all other trees is >25% and the RD of northern white-cedar to hemlock is <50%. Other trees in addition to white-cedar are typically present, including red maple and yellow birch. These seep forests are typically small and are rare to the SLBE area.

When the RD of white-cedar to hemlock was >50%, the White-cedar - (Mixed Conifer) / Alder Swamp (FCS) map class was considered. Particularly within wet-mesic settings, there is a subtle transition between FHS and upland hemlock forests, such that when mapping FHS, both the Hemlock Mesic Forest (FHC) and the Great Lakes Hemlock - Beech - Hardwood Forest (FHB) map classes were kept in mind, depending on the amount of hardwoods present.

For AA, the FHS map class was assessed independently of all other map classes.





Gray Alder Swamp (SAS)

The Gray Alder Swamp (SAS) represents the *Alnus incana* Swamp Shrubland Association (CEGL002381) in the NVCS. It is worth pointing out that although SAS is a shrubland, it is located within the Forest & Woodland Class hierarchy of the NVCS. This map class captures wetland shrublands having >25% shrub cover wherein the RD of gray alder to other shrubs is >25%. Black ash trees may be present with <25% canopy cover. These shrub wetlands are common to the beach and swale sand formations, perhaps most prevalent in the Platte Bay Unit; however, they can be part of a variety of environments, including basins, margins of lakes and ponds, beaver complexes, and riparian zones.

The typical expression of these shrub wetlands includes tall, dense stands where alder is monotypic, with few other shrub species (such as willows) present. When willows and/or dogwoods were dominant, the Dogwood - Willow Swamp (SDW) map class was considered. Hardwoods, such as red maple and black ash, can be present, along with yellow birch and paper birch; however, when hardwoods contributed >25% cover, particularly when the RD of black ash to other hardwoods was >50%, the black ash (FBA) phase of the Black Ash - Mixed Hardwood Swamp map class was considered. Otherwise, the Red Maple - Ash - Birch Swamp Forest (FRM) map class was considered. Likewise, when conifers contributed >25% cover and the RD of northern white-cedar to tamarack was >50%, the White-cedar - (Mixed Conifer) / Alder Swamp (FCS) map class was considered. Otherwise, when the RD of tamarack to white-cedar was >50%, the Northern Tamarack Rich Swamp (FTR) map class was considered. Also, when conifers and hardwoods combined contributed >25% cover, and black ash and white-cedar each met their density criteria for the White-cedar - Black Ash Swamp (FCA), the FCA map class was considered.

For AA, the SAS map class was assessed independently of all other map classes.





Jack Pine / Blueberry / Feathermoss Forest (FJB)

The Jack Pine / Blueberry / Feathermoss Forest (FJB) map class represents the *Pinus banksiana* / *Vaccinium* spp. / *Pleurozium schreberi* Forest Association (CEGL002441) in the NVCS. This map class captures dry, open forests dominated by jack pine with a blueberry understory layer on sandy ridges of dune ridge-and-swale complexes. They are most commonly mapped within the ridge-and-swale complex of the Platte Bay area between the Platte River and Otter River, as well as the complex bayside on South Manitou Island. The RD of hardwoods to conifers is <25%, with a RD of jack pine to eastern white pine and red pine of >50%, yet with a RD of white pine to all pines of <25%. A balsam fir subcanopy is essentially lacking. When the RD of hardwoods to conifers was >25%, particularly of northern red oak and/or black oak with some white oak (often short-statured scrub trees), the Jack Pine - Northern Pin Oak Forest (FJO) map class was considered.

When the mutual RD of hardwoods and conifers was >25% and when the RD of eastern white pine to all pines was >25%, either the White Pine - Red Oak Forest (FWO) or the White Pine - Aspen - Birch Forest (FWA) map class was considered, depending on the RD of various hardwood species to each other (e.g., oaks, bigtooth aspen, red maple). Furthermore, when the RD of white pine to conifers, including jack pine, was >25%, the White Pine / Blueberry Dry-Mesic Forest (FWP) was considered. Likewise, when the RD of red pine to conifers, including jack pine and white pine, was >75%, the Red Pine / Blueberry Dry Forest (FRP) was considered.

When stands of jack pine were on active sand dunes, having an understory layer of typical sand dunal vegetation, including American beachgrass, sandcherry, common juniper, kinnikinnick, and woolly beach-heather (but lacking blueberry), then the Great Lakes Dune Pine Forest (FPD) map class was considered when tree canopy was >60% cover, and either the barrens (HPB) phase or the woodland (HPW) phase of the Great Lakes Coast Pine Barrens map class was considered when tree canopy was <60% cover.

For AA, the FJB map class was assessed independently of all other map classes.





Spruce - Fir - Aspen Forest (FCP)

The Spruce - Fir - Aspen Forest (FCP) map class represents the *Picea glauca - Abies balsamea - Populus tremuloides* / Mixed Herbs Forest Association (CEGL002475) in the NVCS. This map class captures conifer-hardwood forests wherein the mutual RD of white spruce and balsam fir and hardwoods is >25% in the upper canopy. Balsam fir is the primary conifer, with white spruce only nominally present. Hardwoods consist mostly of aspens, yet other hardwoods, including paper birch and red maple, can also be present. Pine trees are few or absent.

The FCP type is known mostly as a boreal-like forest and is somewhat out of place at the SLBE, where extensive northern hardwood forests dominate. The FCP map class was to be used sparingly, only to capture the more palpable examples of these forests; therefore, other map classes were to be thoroughly considered before using the FCP map class. This forest was mapped only on South Manitou Island, presumably only occurring there because of the cooling effect of the lake during the summer.

For AA, the FCP map class was assessed independently of all other map classes.





Black Spruce - Tamarack / Labrador-tea Poor Swamp (FSS and FTP)

The Black Spruce - Tamarack / Labrador-tea Poor Swamp map class represents the *Picea mariana* - (*Larix laricina*) / *Ledum groenlandicum* / *Sphagnum* spp. Forest Association (CEGL005271) in the NVCS. Two map-class phases are used to map the Black Spruce - Tamarack / Labrador-tea Poor Swamp, including black spruce (FSS) and tamarack (FTP). This map class captures rare occurrences of poor swamp forests in peatland settings that are dominated by black spruce and/or tamarack. These swamps receive modest amounts of minerotrophic waters from the adjacent landscape, yet they are still nutrient poor. Northern white-cedar enters these nutrient-poor swamps, particularly along the margins. Tree cover is >25%, which includes trees even as short as tall-shrub height. When tree cover was <25%, the Leatherleaf Poor Fen (DLF) map class was considered. Sphagnum and peatland ericads, including leatherleaf and Labrador-tea, dominate the ground flora, along with other vegetation common to peatlands.

When the RD of black spruce and/or tamarack to other conifers was <25% and the RD of northern white-cedar to all other conifers was >50%, the White-cedar - (Mixed Conifer) / Alder Swamp (FCS) map class was considered; however, if the RD of tamarack to white-cedar was >50%, with an established tall-shrub understory dominated by gray alder, then the Northern Tamarack Rich Swamp (FTR) map class was considered.

The black spruce (FSS) phase captures nutrient-poor swamps wherein the RD of black spruce to all other conifers is >25%. The tamarack (FTP) phase captures nutrient-poor swamps wherein the RD of tamarack to all other conifers is >75%.

For AA, the two map-class phases (FSS and FTP) were combined because they collectively represent one association type. They were, however, left as separate entities in the vegetation map layer.

Black Spruce - Tamarack / Labrador-tea Poor Swamp (black spruce phase)–FSS

The black spruce (FSS) map-class phase represents the Black Spruce - Tamarack / Labrador-tea Poor Swamp map class (as described above). This phase captures nutrient-poor swamp peatlands wherein the RD of black spruce to all other conifers (including tamarack, eastern white pine, eastern hemlock, and northern white-cedar) is >25%. Within these nutrient-poor swamps, when the RD of tamarack to all other conifers was >75%, the tamarack (FTP) phase of this same map class was considered.



Black Spruce - Tamarack / Labrador-tea Poor Swamp (tamarack phase)–FTP

The tamarack (FTP) map-class phase represents the Black Spruce - Tamarack / Labrador-tea Poor Swamp map class (as described above). This phase captures nutrient-poor swamp peatlands wherein the RD of tamarack to all other conifers (including black spruce, eastern white pine, eastern hemlock, and northern white-cedar) is >75%.

Within these nutrient-poor swamps, when the RD of black spruce to all other conifers was >25%, the black spruce (FSS) phase of this same map class was considered.



Northern Tamarack Rich Swamp (FTR)

The Northern Tamarack Rich Swamp (FTR) map class represents the *Larix laricina* / *Alnus incana* Forest Association (CEGL002471) in the NVCS. This map class captures minerotrophic-rich swamp forests wherein the RD of tamarack to northern white-cedar is >50% and the shrub understory is dominant with gray alder. Sphagnum and peatland ericads are lacking or only nominally present. When alder was lacking and peatland flora was more developed, the tamarack (FTP) phase of the Black Spruce - Tamarack / Labrador-tea Poor Swamp map class was considered. The FTR is uncommon at SLBE and shares the same environment as the Gray Alder Swamp (SAS) map class.

The RD of Black spruce to all other conifers is <25%, and the RD of tamarack to other trees (which may consist of northern white-cedar, red maple, black ash, yellow birch, and even some paper birch and eastern white pine) is >50%. When the RD of white-cedar to tamarack was >50%, the White-cedar - (Mixed Conifer) / Alder Swamp (FCS) map class was considered. Also, when understory shrubs were dominant with black chokecherry, the Central Tamarack Poor Swamp (FTS) map class was considered. Both FTS and FTR share the same environment.

For AA, the FTR map class was assessed independently of all other map classes.





White-cedar - (Mixed Conifer) / Alder Swamp (FCS)

The White-cedar - (Mixed Conifer) / Alder Swamp (FCS) map class represents the *Thuja occidentalis* - (*Picea mariana*, *Abies balsamea*) / *Alnus incana* Forest Association (CEGL002456) in the NVCS. This map class captures conifer swamp forests wherein the RD of conifers to hardwoods is >75%, and the RD of northern white-cedar to eastern hemlock is >50%. Balsam fir can be present in high density. Trees can be of short stature. The understory shrub is often of gray alder. Sphagnum and other peatland flora can be common. Hardwoods can be present, such as red maple, yellow birch, paper birch, and black ash; however, when the RD of black ash and red maple hardwoods to conifers was >25%, the White-cedar - Black Ash Swamp (FCA) map class was considered.

These white-cedar swamps can be with open or closed tree canopy. They are saturated wet, yet can easily grade into a wet-mesic version of the White-cedar - Boreal Conifer Mesic Forest association, which is captured with three map-class phases, with the conifer (FCC) phase most similar to FCS. The RD of white-cedar to both eastern hemlock and tamarack is >50%, and the RD of black spruce to all conifers is <25%. When the RD of hemlock to white-cedar was >50%, the Hemlock - Yellow Birch Swamp Wet-Mesic Forest (FHS) map class was considered. Also, when the RD of tamarack to white-cedar was >50% and with an established tall-shrubland understory, either the Central Tamarack Poor Swamp (FTS) map class or the Northern Tamarack Rich Swamp (FTR) map class was considered, depending on the shrub components present. Lastly, when the RD of black spruce and/or tamarack to all conifers was >25% and when peatland flora was well established, either the black spruce (FSS) phase or the tamarack (FTP) phase of the Black Spruce - Tamarack / Labrador-tea Poor Swamp map class was considered.

For AA, the FCS, FCA, and Black Ash - Mixed Hardwood Swamp (FBA) map classes were assessed together. Initial AA results showed confusion between these three map classes, and thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer. The confusion between these map classes were with FBA and FCA, FCA and FCS, but not FBA and FCS.





Bracken Grassland (HBF)

The Bracken Grassland (HBF) map class represents the *Pteridium aquilinum - Bromus kalmii* Herbaceous Vegetation Association (CEGL005142) in the NVCS. This map class captures herbaceous dry sandplains wherein bracken fern strongly dominates the herbaceous layer. Some common juniper might be present but contribute <25% cover. Scrub-shrub and short-tree encroachment is common, yet these types of vegetation contribute <25% cover. When the herbaceous vegetation was more mixed with ruderal species as a result of disturbance, the Ruderal Grassland (HMX) map class was considered.

For AA, the HBF map class was assessed independently of all other map classes.



Conifer Ruderal Shrubland (SCX)

The Conifer Ruderal Shrubland (SCX) map class represents, in part, the Northern & Central Ruderal Meadow & Shrubland Group (G059) of the NVCS. An association type could not be determined because disturbances from human activities (e.g., logging, homestead) lead to variability of floristic vegetation in these shrublands. This map class captures ruderal upland shrublands wherein shrubs contribute >25% cover, and the RD of conifer shrubs to deciduous shrubs is >75%. The characteristic conifer shrub consists of common juniper. These shrublands can be with open or closed canopy, with trees contributing <25% cover.

When trees contributed >25% cover, either the Conifer Ruderal Forest (FCX) map class, the Hardwood Ruderal Forest (FDX) map class, or the Conifer - Hardwood Ruderal Forest (FMX) map class was considered, depending on the RDs of conifers and hardwoods to each other. Conversely, when shrubs contributed <25% cover, the Ruderal Grassland (HMX) map class was considered. The HMX map class also represents, in part, the Eastern Ruderal Shrubland & Grassland Group (G059) in the NVCS.

Because of the disturbance regime inherent to ruderal forests, the SCX map class was not assessed for accuracy.



Deciduous Ruderal Shrubland (SDX)

The Deciduous Ruderal Shrubland (SDX) map class represents, in part, the Northern & Central Ruderal Meadow & Shrubland Group (G059) of the NVCS. An association type could not be determined because disturbances from human activities (e.g., logging, homestead) and natural factors (e.g., wind-throw) lead to variability of floristic vegetation in these shrublands. More occurrences of SDX are caused by human activity than by natural factors. This map class captures ruderal upland shrublands wherein shrubs contribute >25% cover, and the RD of deciduous shrubs to conifer shrubs is >75%. Shrubs consist of any deciduous species common or unique to the SLBE area. These shrublands can be with open or closed canopy, with trees contributing <25% cover.

When the mutual RD of conifer shrubs and deciduous shrubs was >25%, the Conifer - Deciduous Ruderal Shrubland (SMX) map class was considered, which also represents, in part, the Eastern Ruderal Shrubland & Grassland Group (G059) in the NVCS. Also, when trees made up >25% cover, either the Conifer Ruderal Forest (FCX) map class, the Hardwood Ruderal Forest (FDX) map class, or the Conifer - Hardwood Ruderal Forest (FMX) map class was considered, depending on the RDs of conifers and hardwoods to each other. Furthermore, when shrubs contributed <25% cover, the Ruderal Grassland (HMX) map class was considered. The HMX map class also represents, in part, the Eastern Ruderal Shrubland & Grassland Group (G059) in the NVCS.

Because of the variability of vegetation inherent to ruderal shrublands, the SDX map class was not assessed for accuracy.



Conifer - Deciduous Ruderal Shrubland (SMX)

The Conifer - Deciduous Ruderal Shrubland (SMX) map class represents, in part, the Northern & Central Ruderal Meadow & Shrubland Group (G059) of the NVCS. An association type could not be determined because disturbances from human activities (e.g., logging, homestead) and natural factors (e.g., wind-throw) lead to variability of floristic vegetation in these shrublands. Most occurrences of SMX are the result of human activity rather than natural factors. This map class captures ruderal upland shrublands wherein shrubs contribute >25% cover, and the mutual RD of deciduous and conifer shrubs is >25%. Shrubs consist of any species common or unique to the SLBE area. These shrublands can be with open or closed canopy, with trees contributing <25% cover.

When trees contributed >25% cover, either the Conifer Ruderal Forest (FCX) map class, the Hardwood Ruderal Forest (FDX) map class, or the Conifer - Hardwood Ruderal Forest (FMX) map class was considered, depending on the RDs of conifers and hardwoods to each other. Conversely, when shrubs contributed <25% cover, the Ruderal Grassland (HMX) map class was considered. The HMX map class also represents, in part, the Eastern Ruderal Shrubland & Grassland Group (G059) in the NVCS.

Because of the disturbance regime inherent to ruderal forests, the SMX map class was not assessed for accuracy.



Ruderal Grassland (HMX)

The Ruderal Grassland (HMX) map class represents, in part, the Northern & Central Ruderal Meadow & Shrubland Group (G059) of the NVCS. An association type could not be determined because disturbances from human activities (e.g., logging, homestead) and natural factors (e.g., wind-throw) lead to variability of floristic vegetation in these shrublands. This map class captures ruderal, upland, herbaceous fields wherein shrubs and trees each contribute <25% cover. Herbaceous vegetation consists of various grasses and herbs common or unique to the SLBE area; however, the emphasis is on non-native vegetation.

When trees contributed >25% cover, either the Conifer Ruderal Forest (FCX) map class, the Hardwood Ruderal Forest (FDX) map class, or the Conifer - Hardwood Ruderal Forest (FMX) map class was considered, depending on the RDs of conifers and hardwoods to each other. Likewise, when trees contributed <25% cover, yet shrubs contributed >25% cover, either the Conifer Ruderal Shrubland (SCX) map class, the Deciduous Ruderal Shrubland (SDX) map class, or the Ruderal Shrubland (SMX) map class was considered, depending on RDs of conifer and deciduous shrubs to each other. Each of these three shrubland map classes also represents, in part, the Eastern Ruderal Shrubland & Grassland Group (G059) in the NVCS.

Because of the disturbance regime inherent to ruderal herbaceous fields, the HMX map class was not assessed for accuracy.



Inland Freshwater Strand Beach (VAV)

The Inland Freshwater Strand Beach (VAV) map class represents the Inland Freshwater Strand Beach Sparse Vegetation Association (CEGL002310) in the NVCS. This map class captures exposed sand flats with a sparse layer of vegetation, located along margins of interior lakes (but not of Lake Michigan). The VAV map class was used to map the margins of Florence Lake on South Manitou Island, and on the mainland, Bass Lake School Lake, and Shell Lake. The sparse layer of vegetation consists of switchgrass, smooth sawgrass, hardstem bulrush, swamp milkweed, and other wetland forbs, as well as some woody shrub and tree saplings. Some VAV areas were likely too small to map (well below the size of a MMU). In these cases, other wetland map classes, including Open Water Lake (NWL), were used to capture VAV (as inclusions). When essentially no vegetation was present on these sandy beach margins, the Sand & Cobble Beach (NSB) map class was considered.

For AA, the VAV map class was assessed independently of all other map classes.



Great Lakes Beachgrass Dune (HAB)

The Great Lakes Beachgrass Dune (HAB) map class represents the *Ammophila breviligulata* - (*Schizachyrium scoparium*) Herbaceous Vegetation Association (CEGL005098) in the NVCS. This map class captures American beachgrass and little bluestem as the primary vegetation components on sandy shorelines and active sand dunes and foredunes. The herbaceous cover can be low but is usually >10%. Total tree canopy contributes <10% cover, because the constant moving of sands from winds off of Lake Michigan restrict tree propagation in environments of HAB. When tree cover was10–60% and consisted of red pine, eastern white pine, and/or jack pine, the Great Lakes Coast Pine Barrens map class (two phases, including HPB and HPW) was considered; however, when there was an herbaceous understory and tree cover consisting of hardwoods (including eastern cottonwood and paper birch) was >25%, the Cottonwood Dune Open Woodland (WCD) map class was considered.

Within HAB, shrubs of woolly beach-heather, creeping juniper, common juniper, kinnikinnick, willows, and sandcherry may persist, yet these should contribute <20% total cover. When shrubs contributed >20% cover, either the Great Lakes Juniper Dune Shrubland (DJD) map class or the Sand Cherry Dune Shrubland (SCW) map class was considered, depending on RDs of shrub components; however, these shrublands were often represented as inclusions to HAB because they were often in areas smaller than the size of a MMU. When vegetation cover on sandy shorelines was absent or nominal at best, the Sand & Cobble Beach (NSB) map class was considered (these areas were on the Lake Michigan shores where vegetation is prevented from persisting). When vegetation on sand dunes was absent or nominal at best, the blowout (VBO) phase of the Great Lakes Beach was likely considered, unless tree cover consisting of mostly eastern cottonwood was >10%, in which cases the Cottonwood Dune Open Woodland (WCD) map class was considered.

Beachgrass and little bluestem, and the density thereof, was difficult to discern on the aerial photographs because the sand dunes overexposed the CIR imagery, diffusing even moderate density covers of herbaceous vegetation, as well as of short-shrubs, such as sandcherry. Subtle clues were vital to mapping HAB; even the faintest of vegetation appearance on the aerial photos proved to be a significant amount (>25% cover) of beachgrass. Thus, the mapping of HAB was aggressive in order to capture it. Furthermore, because sandcherry was also somewhat diffused by the sand and could not always be seen, it is expected that SCW in areas larger than the size of a MMU may well be mapped within HAB.

For AA, the HAB map class was assessed independently of all other map classes.













Great Lakes Beach (VBO and VES)

The Great Lakes Beach map class represents the *Cakile edentula* Great Lakes Shore Sparse Vegetation Association (CEGL005162) in the NVCS. This map class consists of two phases, blowout (VBO) and erodable sand bank (VES). These two map-class phases were derived to map vegetation of the Great Lakes Beach type that is found on two different landform features. The vegetation is of sparse (<10%) cover and on sand. The VBO phase captures sparse vegetation of sand blowouts on sand dunes. The VES captures sparse vegetation on highly erodible sand-bluff embankments above the coast of Lake Michigan.

For AA, the two map-class phases (VBO and VES) were combined because they collectively represent one association type. They were, however, left as separate entities in the vegetation map layer.

Great Lakes Beach (blowout phase)–VBO

The blowout (VBO) map-class phase represents the Great Lakes Beach map class (as described above) wherein the sparse vegetation is of sand blowouts on sand dunes and shores. Some prominent examples are on the Sleeping Bear Dunes and the dunes on the west shore of South Manitou Island. Vegetation contributes <10% cover and typically contributes <1% cover because of unstable and shifting sands blown from winds off of Lake Michigan. These sand-blowout locations on sand dunes and shores are places where no other vegetation can grow.

Interpreting VBO on the CIR imagery provided some challenges. Vegetation, and the density thereof, was difficult to discern on the aerial photographs because the sand dunes overexposed the CIR imagery, diffusing even moderate density covers of herbaceous vegetation, as well as of short-shrubs, such as sandcherry. Therefore, subtle clues were vital to mapping Great Lakes Beachgrass Dune (HAB); even the faintest of vegetation appearance on the aerial photos proved to be a significant amount (>25% cover) of beachgrass. Thus, the mapping of HAB was aggressive in order to capture it. It is possible that instances of VBO, even those areas larger than the size of a MMU, exist within polygons attributed with the HAB map class. It is also recognized there might be small inclusions, areas smaller than the size of a MMU, of Great Lakes Beachgrass Dune (HAB) and Sand & Cobble Beach (NSB) that exist within polygons attributed with the VBO map-class phase.

When sparse vegetation was on steep, erodable sand-bluff embankments above the coast of Lake Michigan, the erodable sand bank (VES) of this same map class was considered. Erodible sand banks often occur between the rolling sand dunes above and the coastal shoreline below.



Great Lakes Beach (erodable sand bank)–VES

The erodable sand bank (VES) map-class phase represents the Great Lakes Beach map class (as described above) wherein the sparse vegetation is on highly erodable sand-bluff embankments above the coast of Lake Michigan. A prominent example is below the Pierce Stocking Overlook. Erodible sand banks often occur between the rolling sand dunes above and the coastal shoreline below. Vegetation contributes <10% cover and commonly contributes <1% cover because of erosion and wind. Vegetation consists of pioneering herbaceous vegetation, shrubs, and short-statured trees.

When sparse vegetation was on sand blowouts on sand dunes and shores (not on steep, erodible embankments), the blowout (VBO) of this same map class was considered.



Interdunal Wetland (HDW)

The Interdunal Wetland (HDW) map class represents the *Dasiphora fruticosa* ssp. *floribunda* / *Cladium mariscoides* - *Juncus balticus* - (*Rhynchospora capillacea*) Herbaceous Vegetation Association (CEGL005105) in the NVCS. This map class captures small pannes within active dune and sandscape locations. These small wetland pockets are composed usually of smooth sawgrass and northern reedgrass, often with short shrubs consisting of Kalm's St. Johnswort. Typically surrounding these panne wetlands is the Great Lakes Beachgrass Dune (HAB) and other common sand dune and sandscape vegetation types.

The HDW map class was used rarely in mapping, with locations mapped within the sand dunes west of the Platte River and within some sandspits on the eastern shores of North Manitou Island. Other locations of HDW could exist, yet the areas were likely too small to map (well below the size of a MMU).

For AA, the HDW map class was assessed independently of all other map classes.



Great Lakes Juniper Dune Shrubland (DJD)

The Great Lakes Juniper Dune Shrubland (DJD) map class represents the *Juniperus horizontalis - Arctostaphylos uva-ursi - Juniperus communis* Dune Dwarf-shrubland Association (CEGL005064) in the NVCS. This map class captures open short-shrublands on active sand dunes and foredunes. Dominant shrubs consist of creeping juniper, kinnikinnick, and common juniper. It is noteworthy that kinnikinnick can actually be dominant within DJD. Shrubs are often growing in open mats and less commonly in dense, closed mats. American beachgrass and sandcherry are often present, along with woolly beach-heather and willows. Shrub cover is >20%, and the RD of juniper to sandcherry is >20%. When the RD of sandcherry to juniper was >80%, the Sand Cherry Dune Shrubland (SCW) map class was considered. When shrubs contributed <20% cover, the Great Lakes Beachgrass Dune (HAB) map class was considered.

Tree canopy contributes <10 or 25% cover (depending on tree species present) because moving sands and winds off of Lake Michigan limit tree propagation in this environment. Regardless of whether shrub cover was >20%, when tree cover consisting of red pine, eastern white pine, and/or jack pine was 10–60%, either the barrens (HPB) phase or the woodland (HPW) phase of the Great Lakes Coast Pine Barrens map class was considered, depending on density cover of pines. When tree cover was >25% and the RD of northern white-cedar and balsam fir to pines was >40% in the upper canopy, the conifer (FCC) phase of the White-cedar - Boreal Conifer Mesic Forest map class was considered, unless the mutual RD of white-cedar and hardwoods was >25%, in which cases the maple coastal dune (FCM) phase of the same map class was considered. When tree cover was >25% with a RD of hardwoods to conifers of >75%, either the Eastern Cottonwood Woodland (paper birch variant) (WPB) map class or the Cottonwood Dune Open Woodland (WCD) map class was considered, depending on tree component and site location.

Often, DJD was found in areas smaller than the size of a MMU and was, thus, mapped as inclusions to other vegetation types common to sand dunes and foredunes, including HAB, SCW, HPB, HPW, FCC, FCM, WPB, and WCD. These vegetation types are often in proximity to each other, sharing the same sandscape environment.

For AA, the DJD map class was assessed independently of all other map classes.





Great Lakes Coast Pine Barrens (HPB and HPW)

The Great Lakes Coast Pine Barrens map class represents the *Pinus banksiana* - (*Pinus resinosa*) - *Pinus strobus* / *Juniperus horizontalis* Wooded Herbaceous Vegetation Association (CEGL005125) in the NVCS. This map class consists of two phases, barrens (HPB) and woodland (HPW). The Great Lakes Coast Pine Barrens map class captures red pine, eastern white pine, and/or jack pine forests on active sand dunes and foredunes where tree canopy contributes 10–60% cover. Scattered northern white-cedar and balsam fir can occur. The RD of hardwoods to conifers is <25%. Jack pine is often dominant, with little or no white pine or red pine present. When tree cover was >25% and the RD of northern white-cedar and balsam fir to pines was >40% in the upper canopy, the conifer (FCC) phase of the White-cedar - Boreal Conifer Mesic Forest map class was considered, unless the mutual RD of white-cedar (and balsam fir) and hardwoods was >25%, in which cases the maple coastal dune (FCM) phase of the same map class was considered. When tree canopy contributed >60% cover on active sand dunes, the Great Lakes Dune Pine Forest (FPD) map class was considered, unless one of the pine species dominated the forest, in which cases other pine-forest map classes were considered, including the White Pine / Blueberry Dry-Mesic Forest (FWP), the Red Pine / Blueberry Dry Forest (FRP), and the Jack Pine / Blueberry / Feathermoss Forest (FJB) classes.

The ground vegetation is of typical sand dunal species, including American beachgrass, sandcherry, common juniper, woolly beach-heather, willows, and kinnikinnick. It is common to find small pockets (areas smaller than the size of a MMU) of Great Lakes Beachgrass Dune (HAB), Great Lakes Juniper Dune Shrubland (DJD), Sand Cherry Dune Shrubland (SCW), and the blowout (VBO) phase of Great Lakes Beach within the Great Lakes Coast Pine Barrens class.

The barrens (HPB) phase captures the pine barrens wherein the tree canopy contributes 10–25% cover. The woodland (HPW) phase captures the pine barrens wherein the tree canopy contributes 25–60% cover.

For AA, the two map-class phases (HPB and HPW) were combined because they collectively represent one association type. They were, however, left as separate entities in the vegetation map layer.

Great Lakes Coast Pine Barrens (barrens phase)–HPB

The barrens (HPB) map-class phase represents the Great Lakes Coast Pine Barrens map class (as described above) when tree canopy contributes 10–25% cover. When tree canopy contributed 25–60% cover, the woodland (HPW) phase of this same map class was considered.







Great Lakes Coast Pine Barrens (woodland phase)–HPW

The woodland (HPW) map-class phase represents the Great Lakes Coast Pine Barrens map class (as described above) when tree canopy contributes 25–60% cover. When tree canopy contributed 10–25% cover, the barrens (HPB) phase of this same map class was considered.







Eastern Cottonwood Woodland (paper birch variant) (WPB)

The Eastern Cottonwood Woodland (paper birch variant) (WPB) map class represents the *Populus deltoides* Woodland Alliance (A.1493) in the NVCS; an association type within the NVCS was not determined. This map class captures short-statured woodlands consisting mostly of early-successional paper birch, situated on coastal sand slopes above Lake Michigan. Some eastern cottonwood, northern white-cedar, white ash, oaks, and maples may be present. Tree canopy is open, contributing >25% cover when herbaceous and shrubland understory vegetation exist; when understory vegetation is <10% cover, tree canopy can be as low as 10% cover. Pines and other conifers are nominally present or absent. The ground vegetation is of typical sand dunal species, including American beachgrass, sandcherry, common juniper, and kinnikinnick.

When hardwoods contributed <25% cover with an herbaceous understory present, the Great Lakes Beachgrass Dune (HAB) map class was considered; however, when the understory vegetation was <10% cover and hardwoods contributed <10% cover, then the erodible sand bank (VES) phase of the Great Lakes Beach map class was considered. When trees consisted mostly of eastern cottonwood and were situated on the dunal crests and ridges of sand dunes, the Cottonwood Dune Open Woodland (WCD) map class was considered.

For AA, the WPB and the WCD map classes were assessed together. Initial AA results showed confusion between these two map classes; thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer.



Cottonwood Dune Open Woodland (WCD)

The Cottonwood Dune Open Woodland (WCD) map class represents the *Populus deltoides* - (*Juniperus virginiana*) Dune Woodland Association (CEGL005119) in the NVCS. This map class captures woodlands consisting mostly of eastern cottonwood, situated on the dunal crests and ridges of sand dunes. Many times, the trees are of short stature. Some paper birch, northern white-cedar, white ash, oaks, and maples may be present. The tree distribution is often in clumps over the sand dunes; vast open areas of sand are common between clumps of trees. The tree canopy is open, contributing >25% cover when herbaceous and shrubland understory vegetation exist; when understory vegetation is <10% cover, tree canopy can be as low as 10% cover. Pines and other conifers are nominally present or absent. The ground vegetation can include typical sand dunal species and extensive areas with poison ivy.

When hardwoods contributed <25% cover with an herbaceous understory present, the Great Lakes Beachgrass Dune (HAB) map class was considered; however, when the understory vegetation was <10% cover and hardwoods contributed <10% cover, then the blowout (VBO) phase of the Great Lakes Beach map class was considered. When trees consisted mostly of early-successional paper birch and were situated on coastal sand slopes above Lake Michigan, the Eastern Cottonwood Woodland (paper birch variant) (WPB) map class was considered.

For AA, the WCD and the WPB map classes were assessed together. Initial AA results showed confusion between these two map classes; thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer.





Sand Cherry Dune Shrubland (SCW)

The Sand Cherry Dune Shrubland (SCW) map class represents the *Prunus pumila* - (*Ptelea trifoliata*) Dune Shrubland Association (CEGL005075) of the NVCS. This map class captures dry, semi-sparse short-shrublands that are dominated by sandcherry, bayberry willow, and Missouri River willow and are located on sand dunes. Sandcherry does not necessarily need to be the dominant shrub. Other dunal shrubs often co-exist in sparse amounts, including kinnikinnick and woolly beach-heather. Total shrub cover is >20%; however, when the combined RD of creeping juniper, kinnikinnick, and common juniper to sandcherry and other shrubs was >20%, the Great Lakes Juniper Dune Shrubland (DJD) map class was considered. When shrubs contributed <20% cover, the Great Lakes Beachgrass Dune (HAB) map class was considered. Regardless of whether or not the shrub cover was >20%, when tree cover was 10–60% and consisted of red pine, eastern white pine, and/or jack pine, either the barrens (HPB) phase or the woodland (HPW) phase of the Great Lakes Coast Pine Barrens map class was considered, depending on density cover of pines.

Short-statured shrubs, including sandcherry and willows, and the density thereof, was difficult to discern on the aerial photographs because the sand dunes overexposed the CIR imagery, diffusing even moderate density covers of shrub vegetation, as well as herbaceous vegetation. Shrubs were most evident on slopes and less so on level plains and summits of the dunes. It is expected that SCW occurring in areas greater than the size of a MMU, particularly in areas occurring on the tops of dunes, were possibly mapped within HAB.

For AA, the SCW map class was assessed independently of all other map classes.





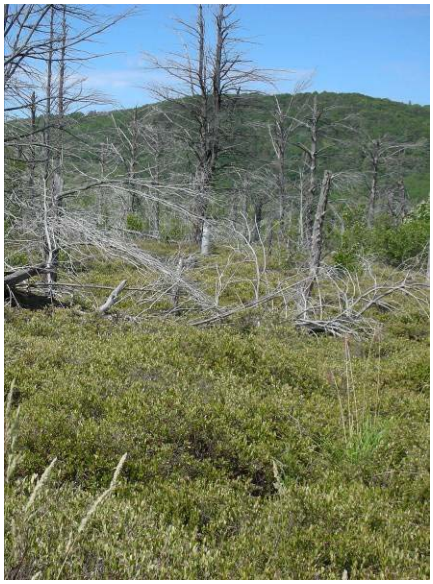
Leatherleaf Poor Fen (DLF)

The Leatherleaf Poor Fen (DLF) map class represents the *Chamaedaphne calyculata* / *Carex oligosperma* / *Sphagnum* spp. Poor Fen Dwarf-shrubland Association (CEGL005277) in the NVCS. This map class captures poor fens within peatlands that are dominated by leatherleaf and other shrubs including small cranberry and purple chokeberry. These peatlands are located within basins receiving low minerotrophic influence from surrounding water sources, either directly (as with seasonal flooding from beaver pond complexes or rivers) or indirectly (as with the sandy lakeplain of Lake Michigan). When located near water sources as described above, either the Leatherleaf - Sweetgale Shore Fen (DLS) map class or the Shrubby-cinquefoil - Sweetgale Rich Shore Fen (SSF) map class was considered (sweetgale is commonly associated with minerotrophic-rich shorefens).

Scattered black spruce, tamarack, and white pine are commonly present, but canopy cover (even as short-tree or tall-shrub) is <25%. When black spruce and/or tamarack contributed >25% cover over the ericad layer, either the black spruce (FSS) phase or the tamarack (FTP) phase of the Black Spruce - Tamarack / Labrador-tea Poor Swamp map class was considered, depending on densities of tree species.

For AA, the DLF map class was assessed independently of all other map classes.





Great Lakes Sedge Rich Shore Fen (HSM)

The Great Lakes Sedge Rich Shore Fen (HSM) map class represents the *Calamagrostis canadensis - Carex viridula - Cladium mariscoides - Lobelia kalmii* Herbaceous Vegetation Association (CEGL005115) in the NVCS. This map class captures minerotrophic-rich, herbaceous shorefens along margins of lakes with vegetation consisting of smooth sawgrass and other herbaceous associates. Examples of lakes include Lake Florence on South Manitou Island, School Lake, and Bass Lake. It is worth noting that some sites of HSM at SLBE are not typical examples of the vegetation type, yet HSM is a best fit in classifying these areas. (HSM is typically more mineral rich with cobble or bedrock than are sites at SLBE.) Some flooding may occur during lake swelling.

Some sites occurring in beach-swale depressions within sand ridge-and-swale complexes were mapped by using the HSM map class. These sites, however, were difficult to discern from Northern Great Lakes Emergent Marsh (HEM) by using aerial imagery.

For AA, the HSM, HEM, Midwest Mixed Emergent Deep Marsh (HCM), and Woolly-fruit Sedge Shore Fen (HSS) map classes were assessed together. Initial AA results showed confusion between these four map classes, and thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer.







Wiregrass Sedge Shore Fen (HSS)

The Wiregrass Sedge Shore Fen (HSS) map class represents the *Carex lasiocarpa* - (*Carex rostrata*) - *Equisetum fluviatile* Herbaceous Vegetation Association (CEGL005229) in the NVCS. This map class captures seasonally saturated, sedge-dominated shorefens on sphagnum peat that receive minerotrophic influence from adjacent water sources; these can form into floating peat mats. These minerotrophic-rich, herbaceous shorefens often receive flooding. Woollyfruit sedge, along with smooth sawgrass, is the characteristic herbaceous components. Ericads and other nutrient-poor fen vegetation are essentially absent. At SLBE, HSS is rare and was mapped only at Round Lake just north of Crystal Lake in the Platte Bay Unit.

In contrast to HSS, the Northern Sedge Wet Meadow (HSG) map class was used to map sedge meadows where there was a wetland substrate consisting of muck rather than peat. Also in contrast to HSS, the Leatherleaf - Sweetgale Shore Fen (DLS) map class or the Shrubby-cinquefoil - Sweetgale Rich Shore Fen (SSF) was used to map shrub shorefens wherein sweetgale and/or leatherleaf contributed >25% cover.

When the RD of other emergent vegetation occurring in deeper marsh (e.g., bulrushes and cattails) to sedges and other herbaceous vegetation characteristic of HSS was >50%, the Northern Great Lakes Emergent Marsh (HEM) map class was considered.

For AA, the HSS, HEM, Great Lakes Sedge Rich Shore Fen (HSM), and Midwest Mixed Emergent Deep Marsh (HCM) map classes were assessed together. Initial AA results showed confusion between these four map classes, and thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer.



Leatherleaf - Sweetgale Shore Fen (DLS)

The Leatherleaf - Sweetgale Shore Fen (DLS) map class represents the *Chamaedaphne calyculata - Myrica gale* / *Carex lasiocarpa* Dwarf-shrubland Association (CEGL005228) in the NVCS. This map class captures seasonally saturated shorefens on sphagnum peat that are dominated by short shrubs (>25% cover). Short-shrubs consist primarily of sweetgale and/or leatherleaf. These minerotrophic-rich shorefens are typical along streams and small lake or pond basins receiving seasonal flooding. Examples of DLS exist along Otter Creek of the Platte Bay Unit and along Tamarack Lake on North Manitou Island.

Other dwarf-shrub ericads may include some bog rosemary and cranberry. Tamarack and northern white-cedar may be scattered, with canopy cover of <25%. Also, tall-shrubs (including gray alder and willows) may be present but contribute <25% cover. When >25% cover consisted of tall-shrubs, then either the Dogwood - Willow Swamp (SDW) map class or the Gray Alder Swamp Shrubland (SAS) map class was considered. When leatherleaf dwarf-shrublands were found within nutrient-poor fen environments not receiving minerotrophic waters from river or basin flooding, the Leatherleaf Poor Fen (DLF) map class was considered.

In contrast to DLF, the Shrubby-cinquefoil - Sweetgale Rich Shore Fen (SFF) map class was used to map shrub shorefens wherein leatherleaf was absent, yet sweetgale and shrubby-cinquefoil were present. Also in contrast to DLF, the Wiregrass Sedge Shore Fen (HSS) map class was used to map sedge shorefens wherein shrubs were <25% cover.

For AA, the DLS map class was assessed independently of all other map classes.



Shrubby-cinquefoil - Sweetgale Rich Shore Fen (SSF)

The Shrubby-cinquefoil - Sweetgale Rich Shore Fen (SFF) map class represents the *Dasiphora fruticosa ssp. floribunda - Myrica gale* Rich Shore Fen Shrubland Association (CEGL005275) in the NVCS. This map class captures seasonally saturated shorefens within stream corridors wherein shrubs contribute >25% cover and vegetation consists primarily of sweetgale and shrubby-cinquefoil. Dwarf-shrubs of leatherleaf are absent. Shalda Creek provides a good example of SSF at SLBE. It is worth noting that a few sites on the shores of some lakes were mapped by using the SSF map class. These sites, since they are not streamside, might be more appropriately described by the Northern Great Lakes Emergent Marsh (HEM), Great Lakes Sedge Rich Shore Fen (HSM), and the Gray Alder Swamp (SAS) map classes.

In contrast to SSF, the Leatherleaf - Sweetgale Shore Fen (DLS) map class was used to map shrub shorefens wherein leatherleaf (with or without sweetgale) contributed >25% cover. Also in contrast to SSF, the Wiregrass Sedge Shore Fen (HSS) map class was used to map sedge shorefens wherein shrubs were <25% cover.

When the RD of alder, dogwood, willows, and/or black chokecherry to sweetgale and shrubby-cinquefoil was >25%, either the Gray Alder Swamp (SAS) map class or the Dogwood - Willow Swamp map class (consisting of two phases, including dogwood - willow [SDW] and black chokecherry [SBC]) was considered.

For AA, the SSF map class was assessed independently of all other map classes.



Inland Coastal Plain Marsh (HCP)

The Inland Coastal Plain Marsh (HCP) map class represents the *Rhynchospora capitellata - Rhexia virginica - Rhynchospora scirpoides - Schoenoplectus hallii* Herbaceous Vegetation Association (CEGL005108) in the NVCS. This map class captures a rare wet meadow consisting of primarily needle beaksedge and hardstem bulrush. This herbaceous wetland was mapped only in the Bow Lakes area. Other locations of HCP might exist at SLBE. If so, they were either areas smaller than the size of the MMU or they were not recognized during mapping. Many locations of HCP might be mapped with the Northern Sedge Wet Meadow (HSG) map class.

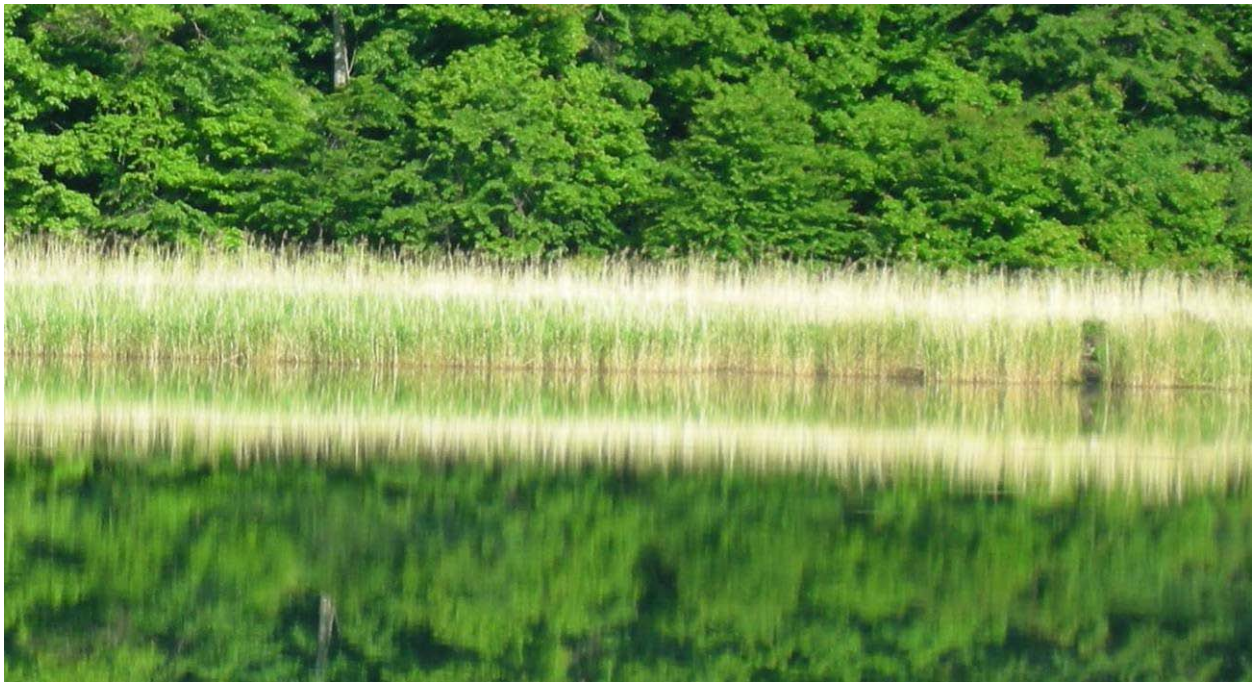
For AA, the HCP map class was assessed independently of all other map classes.



Eastern Reed Marsh (HPG)

The Eastern Reed Marsh (HPG) map class represents *Phragmites australis* Eastern North America Temperate Semi-natural Herbaceous Vegetation Association (CEGL004141) in the NVCS. This map class captures deep-marsh wetlands that are dominant with eastern reed, often growing in monotypic stands. The RD of eastern reed to other emergent vegetation is >80%. When <80%, either the Northern Great Lakes Emergent Marsh (HEM) map class or the Midwest Mixed Emergent Deep Marsh (HCM) map class was considered, depending on the RDs of herbaceous vegetation species present.

For AA, the HPG map class was assessed independently of all other map classes.







Northern Great Lakes Emergent Marsh (HEM)

The Northern Great Lakes Emergent Marsh (HEM) map class represents the *Schoenoplectus acutus - Schoenoplectus subterminalis - Eleocharis palustris* - (*Schoenoplectus americanus*) Northern Great Lakes Shore Herbaceous Vegetation Association (CEGL005274) in the NVCS. This map class captures emergent-marsh wetlands that are dominated by bulrushes (commonly hardstem bulrush) and often are mixed with other emergent vegetation, including cattails, eastern reed, sedges, and bluejoint. The RD of bulrushes to other emergents, including cattails, should be >50%; however, at the time of mapping, the mapping conventions were built with a misunderstanding of the RD criteria regarding cattail and other emergent vegetation, thus resulting in some misapplication of the vegetation classification in the mapping of HEM and Midwest Mixed Emergent Deep Marsh (HCM). An incorrect criteria was applied to the mapping of HCM wherewith the required RD of cattail to other emergents (including bulrushes) was thought to be >80% instead of >50%. This resulted in overly aggressive mapping of HEM, whereas the mapping of HCM was not aggressive enough.

In addition to the misapplied criteria described above, the mapping of certain wetland types, including HEM, HCM, Northern Sedge Wet Meadow (HSG), and Bluejoint Wet Meadow (HCC), was complicated by temporal changes going on within the wetlands, particularly in those wetlands occurring within the sand ridge-and-swale complexes. From results of the field reconnaissance used to determine mapping decisions, it became evident that ground conditions were seasonally dry when aerial photo imagery was acquired and seasonally wet at the time of field reconnaissance. For example, during field reconnaissance, inundated wetlands had an even mixture of hardstem bulrush and bluejoint.

For AA, the HEM, HCM, Great Lakes Sedge Rich Shore Fen (HSM), and Woolly-fruit Sedge Shore Fen (HSS) map classes were assessed together. Initial AA results showed confusion between these four map classes, and thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer.





Midwest Mixed Emergent Deep Marsh (HCM)

The Midwest Mixed Emergent Deep Marsh (HCM) map class represents the *Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation Association (CEGL002229) in the NVCS. This map class captures deep-marsh emergent wetlands dominated by cattails with little mixture of other emergent vegetation, including bulrushes (commonly hardstem bulrush). The RD of bulrushes to other emergents, including cattails, should be >50%; however, at the time of mapping, the mapping conventions were built with a misunderstanding of the RD criteria regarding cattail and other emergent vegetation, thus resulting in some misapplication of the vegetation classification in the mapping of HCM and Northern Great Lakes Emergent Marsh (HEM). An incorrect criteria was applied to the mapping of HCM wherewith the required RD of cattail to other emergents (including bulrushes) was thought to be >80% instead of >50%. This resulted in overly aggressive mapping of HEM, whereas the mapping of HCM was not aggressive enough.

In addition to the misapplied criteria described above, the mapping of certain wetland types, including HEM, HCM, Northern Sedge Wet Meadow (HSG), and Bluejoint Wet Meadow (HCC), was complicated by temporal changes going on within the wetlands, particularly in those occurring within the sand ridge-and-swale complexes. From results of the field reconnaissance used to determine mapping decisions, it became evident that ground conditions were seasonally dry when aerial photo imagery and seasonally wet at the time of field reconnaissance.

For AA, the HCM, HEM, Great Lakes Sedge Rich Shore Fen (HSM), and Woolly-fruit Sedge Shore Fen (HSS) map classes were assessed together. Initial AA results showed confusion between these four map classes, and thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer.





Wet Meadow Mixed Herbaceous (HWM)

The Wet Meadow Mixed Herbaceous (HWM) map class represents mixed herbaceous wetlands within the Eastern North American Wet Meadow Group (G112) in the NVCS. This map class captures wetland meadows receiving disturbance from dynamic hydrology—from human or beaver activities—and wherein there is a diverse mix of emergent herbaceous vegetation (pioneering and persistent). The disturbance is such that the community of vegetation is non-distinct to any one established herbaceous vegetation type, particularly Bluejoint Wet Meadow (HCC) and Northern Sedge Wet Meadow (HSG). Although bluejoint and sedges are common to HWM sites, the RDs of each to the mix of herbaceous vegetation is <25%. Woolgrass can be a common component of HWM. It is noteworthy that herbaceous beaver meadows can be classified as HWM, HCC, or HSG, depending on beaver activity and subsequent vegetation response. Those beaver meadows with frequent or recent changes were likely assigned the HWM map class during mapping.

Trees and shrubs are often present, but they each contribute <25% cover. When shrubs contributed >25% cover and predominantly consisted of gray alder, the Gray Alder Swamp Shrubland (SAS) map class was considered, unless the sites consisted more of dogwood and/or willow, in which cases the dogwood - willow (SDW) phase of the Dogwood - Willow Swamp map class was considered. When tree canopy contributed >25% cover, hardwoods were most common, and either the Red Maple - Ash - Birch Swamp Forest (FRM) map class or the Black Ash - Mixed Hardwood Swamp (FBA) map class was considered, depending on dominance of hardwoods present.

For AA, the HWM and HCC map classes were assessed together. Initial AA results showed confusion among these two map classes; thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer.





Bluejoint Wet Meadow (HCC)

The Bluejoint Wet Meadow (HCC) map class represents the *Calamagrostis canadensis - Eupatorium maculatum* Herbaceous Vegetation Association (CEGL005174) in the NVCS. This map class captures herbaceous wetland meadows that are characterized by bluejoint; they are commonly receptive to beaver activity. Sedges are often present, but their RD to all herbaceous vegetation is <25%. Barring sedges, cattails, and bulrushes, the RD of bluejoint to all other emergent herbaceous vegetation is >25%.

When the RD of sedges to bluejoint was >25%, the Northern Sedge Wet Meadow (HSG) map class was considered. When the amount of bluejoint component relative to sedges could not be determined from aerial photographs, the HSG map class was typically the default map class. When herbaceous vegetation consisted of a diverse mix and the RD of bluejoint and sedges to herbaceous vegetation was each <25%, the Wet Meadow Mixed Herbaceous (HWM) map class was considered.

For AA, the HCC and HWM map classes were assessed together. Initial AA results showed confusion among these three map classes; thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer.





Northern Sedge Wet Meadow (HSG)

The Northern Sedge Wet Meadow (HSG) map class represents the *Carex* (*rostrata, utriculata*) - *Carex lacustris* - (*Carex vesicaria*) Herbaceous Vegetation Association (CEGL002257) in the NVCS. This map class captures herbaceous wetland meadows characterized by sedges wherein the RD of sedges to other herbaceous vegetation (barring the deep-emergent vegetation of cattails and bulrushes) is >25%. The substrate is not so much peat mat, but rather muck. When the RD of sedges to herbaceous vegetation was <25%, either the Bluejoint Wet Meadow (HCC) map class or the Wet Meadow Mixed Herbaceous (HWM) map class was considered, depending on density of herbaceous components present. (The HWM map class was considered when herbaceous vegetation consisted of a diverse mix and the RD of bluejoint and sedges to herbaceous vegetation was each <25%.) When the amount of bluejoint component relative to sedges could not be determined from aerial photographs, the HSG map class was typically the default.

These sedge wetland meadows can occur on varying landscapes, including beaver meadows, sand ridge-and-swale complexes, streamside corridors, and small basins. The Inland Coastal Plain Marsh (HCP) map class, which represents a rare wet meadow and was mapped only in the Bow Lakes area, was considered when the vegetation consisted primarily of needle beaksedge and hardstem bulrush. It should be noted that other locations of HCP that were either smaller than the area of a MMU or were not recognized during mapping might be mapped with the HSG map class. Furthermore, the Upright Sedge Wet Meadow (HUS) map class was considered when the sedge meadow was dominant with upright sedge, which is difficult to discern on aerial imagery; the mapping of HUS was reserved to the Crystal River between Glen Lake and Lake Michigan (Good Harbor Bay Unit).

When sedge meadows were in shorefen locations that receive minerotrophic influence from adjacent water sources and are seasonally saturated and with sphagnum peat, the Wiregrass Sedge Shore Fen (HSS) map class was considered.

When the RD of shrubs, including alder, dogwood, willows, black chokecherry, sweetgale, and shrubby-cinquefoil, was >25%, one of several map classes representing shrubland types was considered.

For AA, the HSG and HUS map classes were assessed together. Initial AA results indicated confusion between these two map classes; thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer.







Upright Sedge Wet Meadow (HUS)

The Upright Sedge Wet Meadow (HUS) map class represents the *Carex stricta* - *Carex* spp. Herbaceous Vegetation Association (CEGL002258) in the NVCS. This map class captures herbaceous meadows that are dominated by upright sedge and, at SLBE, occur within the floodplain of the Crystal River in the Good Harbor Bay Unit between Glen Lake and Lake Michigan; the HUS type at SLBE is rare. Discerning HUS sites from other sedge meadows, particularly the Northern Sedge Wet Meadow (HSG), was difficult by using aerial imagery. Thus, the use of the HUS map class was restricted to the Crystal River, which is where HUS is known to occur from field visits.

For AA, the HUS and HSG map classes were assessed together. Initial AA results indicated confusion between these two map classes; thus, they were combined in order to reach confidence standards. These map classes were, however, left as separate entities in the vegetation map layer.



Dogwood - Willow Swamp (SDW and SBC)

The Dogwood - Willow Swamp (SDW) represents the Cornus sericea - Salix spp. - (*Rosa palustris*) Shrubland Association (CEGL002186) in the NVCS. This map class consists of two phases, dogwood - willow (SDW) and black chokecherry (SBC). This map class captures swamp shrublands having >25% shrub cover dominated by dogwoods, willows, and or black chokecherry. If present at all, the RD of gray alder to shrubs is <25%. When the RD of alder to shrubs was >25%, the Gray Alder Swamp Shrubland (SAS) map class was considered. The Dogwood - Willow Swamp can be in perched basins, streambeds, and sandy lakeplains (e.g., sand ridge-and-swale complex).

When shrubs contributed <25% cover, other herbaceous wetland map classes were considered, including Bluejoint Wet Meadow (HCC), Northern Sedge Wet Meadow (HSG), and Wet Meadow Mixed Herbaceous (HWM), depending on herbaceous components and site locations. When sites were more fen-like, with sweetgale prominent, the Shrubby-cinquefoil - Sweetgale Rich Shore Fen (SSF) map class was considered.

The dogwood - willow (SDW) phase captures the shrub wetland wherein the shrubs are dominated by dogwoods and willows. The black chokecherry (SBC) phase captures the shrubs when they are dominated by black chokecherry. The SBC phase was mapped only in the Platte Bay Unit between the Platte River and Otter Creek, located on the sand ridge-and-swale complex and sandy lakeplain. Vegetation in the SBC phase is mapped in proximity to vegetation in the SDW phase; the SDW phase was mapped more extensively and more broadly across the SLBE landscape.

For AA, the two map-class phases (SDW and SBC) were combined because they collectively represent one association type. They were, however, left as separate entities in the vegetation map layer.

Dogwood - Willow Swamp (dogwood - willow phase)–SDW

The dogwood - willow (SDW) map-class phase represents the Dogwood - Willow Swamp map class (as described above) wherein the shrub wetland is dominated by dogwoods and willows. Black chokecherry can be present, but its RD to other shrubs is <50%. When the RD of chokecherry to all other shrubs was >50%, the black chokecherry (SBC) phase of this same map class was considered.





Dogwood - Willow Swamp (black chokecherry phase)–SBC

The black chokecherry (SBC) map-class phase represents the Dogwood - Willow Swamp map class (as described above) wherein the shrub wetland is dominated with black chokecherry. Dogwoods, willows, and other shrubs can be present, but their RD to black chokecherry is <50%. When the RD of dogwoods and willows to all other shrubs was >50%, the dogwood - willow (SDW) phase of this same map class was considered.

Short-statured trees of tamarack and some northern white-cedar can be present; however, when tree canopy was >25% cover, particularly of tamarack, the Central Tamarack Poor Swamp (FTS) map class was considered.

The SBC phase was mapped only in Platte Bay Unit between the Platte River and Otter Creek, located on the sand ridge-and-swale complex and sandy lakeplain. Vegetation in the SBC phase is mapped in proximity to vegetation in the SDW phase; the SDW phase was mapped more extensively and more broadly across the SLBE landscape.



Northern Water-lily Aquatic Wetland (HFA)

The Northern Water-lily Aquatic Wetland (HFA) map class represents the *Nymphaea odorata - Nuphar* (*microphylla*, *variegata*) Herbaceous Vegetation Association (CEGL002562) in the NVCS. This map class captures deep water marshes wherein floating-leaved aquatic vegetation (mostly of variegated yellow pond-lily and American white waterlily) contributes >10% cover, with emergent vegetation contributing <10% cover. Submergent vegetation, such as floating pondweed, may be of high density. The vegetation of HFA is customary to small ponds and lakes located landward from Lake Michigan.

Some of the floating aquatic and submergent vegetation had senesced before aerial photography was collected in October, thus making detection of HFA via photography limited. Sites of HFA were mapped when floating aquatic vegetation was observable on the fall aerial photographs. It is anticipated that more HFA covering areas greater than the size of a MMU existed at the time photography was obtained than what could actually be observed on the photographs. It is most likely that these unveiled areas of HFA were captured in the Midwest Pondweed Submerged Aquatic Wetland (HSV) map class, because HSV shares the same deep water marsh environment as HFA. Readers should refer to the HSV map-class description to understand the aggressive approach in mapping HSV and how HFA might be further represented.

For AA, the HFA map class was assessed independently of all other map classes.



Midwest Pondweed Submerged Aquatic Wetland (HSV)

The Midwest Pondweed Submerged Aquatic Wetland (HSV) map class represents the *Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation Association (CEGL002282) in the NVCS. This map class captures deep water marshes wherein submergent vegetation (most commonly coon's-tail, slender watermilfoil, and various pondweeds) contributes >10% cover, with emergent herbaceous vegetation and floating-leaved aquatic vegetation each contributing <10% cover. The vegetation of HSV is customary to small ponds and lakes located landward from Lake Michigan.

Some of the submergent and floating aquatic vegetation had senesced before aerial photography was collected in October, thus, making detection of HSV via photography limited. Sites of HSV were mapped when submergent vegetation was observable on the fall aerial photographs. It is anticipated that more HSV in areas greater than the size of a MMU existed at the time photography was obtained than what could actually be observed on the photographs. Thus, the approach in mapping most ponds was to assign the HSV map class even when appearance of submergent vegetation was lacking. This was an aggressive effort to map HSV based on likely locations. Again, this decision was based on field experience, which indicated that most ponds contained submergent vegetation. When the HSV map class was assigned to ponds appearing as open water on the aerial photographs, the 10–25% cover density (physiognomic modifier) was applied to the map-class attribute.

When the RD of floating aquatic vegetation to submerged aquatic vegetation was >10%, the Northern Water-lily Aquatic Wetland (HFA) map class was considered. Furthermore, regardless of the amount of submerged and floating aquatic vegetation, when the RD of emergent vegetation to aquatic vegetation was >10%, other wetland emergent map classes were considered.

When open water bodies <8 ha in area were determined to be too deep for submergent and floating aquatic vegetation to grow, the Open Water Pond (NWP) map class was considered. In open water bodies >8 ha in area, the Open Water Lake (NWL) map class was considered. The NWP and NWL map classes are not represented in the NVCS.

For AA, the HSV map class was assessed independently of all other map classes.



Deciduous Orchard (FOD)

The Deciduous Orchard (FOD) map class falls under the Agricultural Vegetation Cultural Class (7) in the NVCS, wherein it is defined down to Level 6, Fruit - Orchards Subgroup. This map class captures deciduous fruit tree orchards, most of which are active. The FOD map class was also used to map a couple of the older remnant cherry orchards (those showing row formations) located on North Manitou Island. These remnant orchards are no longer active but show the historical use of the area on the island. When row formations became ambiguous, the hardwood mix (FDX) phase of the Hardwood Ruderal Forest map class or the Deciduous Ruderal Shrubland (SDX) map class was considered.

Because the FOD is a cultural vegetation map class, it was not assessed for accuracy.



Crop Field (HCF)

The Crop Field (HCF) map class falls under the Agricultural Vegetation Cultural Class (7) in the NVCS, wherein it is defined down to Level 3, Cultivated Crop Formation. This map class captures areas cultivated for row crops (e.g., corn, soybeans) or improved pasture of monotypic or biennial herbaceous vegetation (e.g., alfalfa, clover). When fields are of perennial vegetation and used for pasturing, even when occasional haying might occur, the Pasture Field (HPF) map class was considered.

Because the HCF is a cultural vegetation map class, it was not assessed for accuracy.



Pasture Field (HPF)

The Pasture Field (HPF) map class falls under the Agricultural Vegetation Cultural Class (7) in the NVCS, wherein it is defined down to Level 4, Permanent Pasture & Hayland Subformation. This map class captures herbaceous lands of perennial grasses and forbs allowed to grow naturally. These lands are cut for hay and/or used for pasture. For lands that were left idle—that is, were not actively being used for agricultural purposes—the Ruderal Grassland (HMX) map class was considered. For lands improved for haying (e.g., alfalfa, clover), the Crop Field (HCF) map class was considered. With changing land use practices, distinctions between HPF and the improved pastures of HCF, as well as between HPF and the fallow fields of HMX, can be subtle.

Because the HPF is a cultural vegetation map class, it was not assessed for accuracy.

No representative pictures are available.

Developed Area (CDV)

The Developed Area (CDV) map class falls under the Developed Vegetation Cultural Class (8) in the NVCS, wherein it is defined down to Level 3, Other Developed Urban / Built Up Vegetation Formation. From there, finer break outs are defined with the use of modifiers to depict the amount of impervious surface of developed areas. These modifiers represent classes 21–24 in the NLCD. The CDV map class captures areas having regular human use. Examples at the SLBE include roads and their right-of-ways, urban areas, homesteads and farmsteads, campgrounds, picnic areas, and various SLBE grounds (such as visitor centers and building structures).

The following sections describe classes 21–24 in the NLCD, which were used to further attribute (using a special modifier) the CDV map class. The High Intensity (24) class was not used for the mapping of SLBE, yet a description of it is included here for completeness and comparison purposes. Definitions are taken from the NLCD.

Open Space – 21 (O)

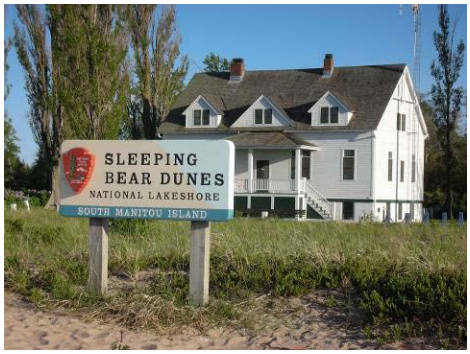
This class includes areas consisting mostly of vegetation in the form of lawn grasses but that also have a mixture of some constructed materials. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot, single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.





Low Intensity – 22 (L)

This class includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20–49% of total cover. These areas most commonly include single-family housing units.





Medium Intensity – 23 (M)

This class includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50–79% of total cover. These areas most commonly include single-family housing units.



High Intensity – 24 (H)

This class includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses, and commercial/industrial facilities. Impervious surfaces account for 80–100% of the total cover.

No representative pictures are available.

Because CDV is a cultural vegetation map class, it was not assessed for accuracy.

Stream & River (NSR)

The Stream & River (NSR) map class represents, in part, the Open Water (11) class in the NLCD. This map class captures open water streams and rivers. Submergent aquatic vegetation may be sparsely present (usually in shallow waters close to shorelines), but sites should have <10% vegetation. When submergent vegetation contributed >10% cover, the Midwest Pondweed Submerged Aquatic Wetland (HSV) map class was considered. Some examples of NSR are Shalda Creel, Crystal River, Otter Creek, and Platte River.

Because NSR is a non-vegetation map class, it was not assessed for accuracy.



Open Water Pond (NWP)

The Open Water Pond (NWP) map class represents, in part, the Open Water (11) class in the NLCD. This map class captures open water bodies <8 ha in area. For open water bodies >8 ha, the Open Water Lake (NWL) map class was considered, which also represents, in part, the Open Water (11) class in the NLCD. These ponds are usually deep enough such that vegetation is unable to take root. Wetland vegetation—emergent and/or aquatic—may be present (usually in shallow waters close to shorelines) but should contribute <10% cover.

Usually, shallow ponds within beaver meadows and sandscape ponds provide an environment for wetland vegetation to thrive, and some allow for aquatic vegetation. Some of the aquatic vegetation had senesced before aerial photography was collected in October; therefore, detection via photography was limited. This posed a problem for mapping the Midwest Pondweed Submerged Aquatic Wetland (HSV) and Northern Water-lily Aquatic Wetland (HFA) classes. Thus, the approach to mapping most shallow ponds appearing as open water on the aerial photographs was to assign such units to the HSV map class. This was an aggressive effort to map aquatic vegetation based on likely locations.

Because NWP is a non-vegetation map class, it was not assessed for accuracy.



Open Water Lake (NWL)

The Open Water Lake (NWL) map class represents, in part, the Open Water (11) class in the NLCD. This map class captures open water bodies that are >8 ha in area and have <10% vegetation present. When open water bodies were <8 ha in area, the Open Water Pond (NWP) map class was considered, which also represents, in part, the Open Water (11) class in the NLCD. The NWL map class captures, in essence, the Lake Michigan waters along SLBE, as well as interior lakes more landward, including Lake Manitou, Florence Lake, Shell Lake, Bass Lake, School Lake, Little Traverse Lake, Glen Lake, Otter Lake, Little Platte Lake, Platte Lake, Loon Lake, Rush Lake, Long Lake, and Crystal Lake.

Because NWL is a non-vegetation map class, it was not assessed for accuracy.





Sand & Cobble Beach (NSB)

The Sand & Cobble Beach (NSB) map class represents the Barren Land (31) class in the NLCD. This map class captures sand and cobble shorelines that largely lack vegetation along Lake Michigan and some interior lakes. Beaches of Lake Michigan have persistent and direct impacts from the lake such that vegetation types cannot establish. When vegetation was present along shorelines of Lake Michigan, particularly with American beachgrass as the primary vegetation, the Great Lakes Beachgrass Dune (HAB) map class was considered. When a sparse layer of vegetation was present along interior lake shorelines, the Inland Freshwater Strand Beach (VAV) map class was considered. Vegetation characteristic of VAV consisted of switchgrass, hardstem bulrush, swamp milkweed, and other wetland forbs, as well as some woody shrub and tree saplings.

Because NSB is a non-vegetation map class, it was not assessed for accuracy.

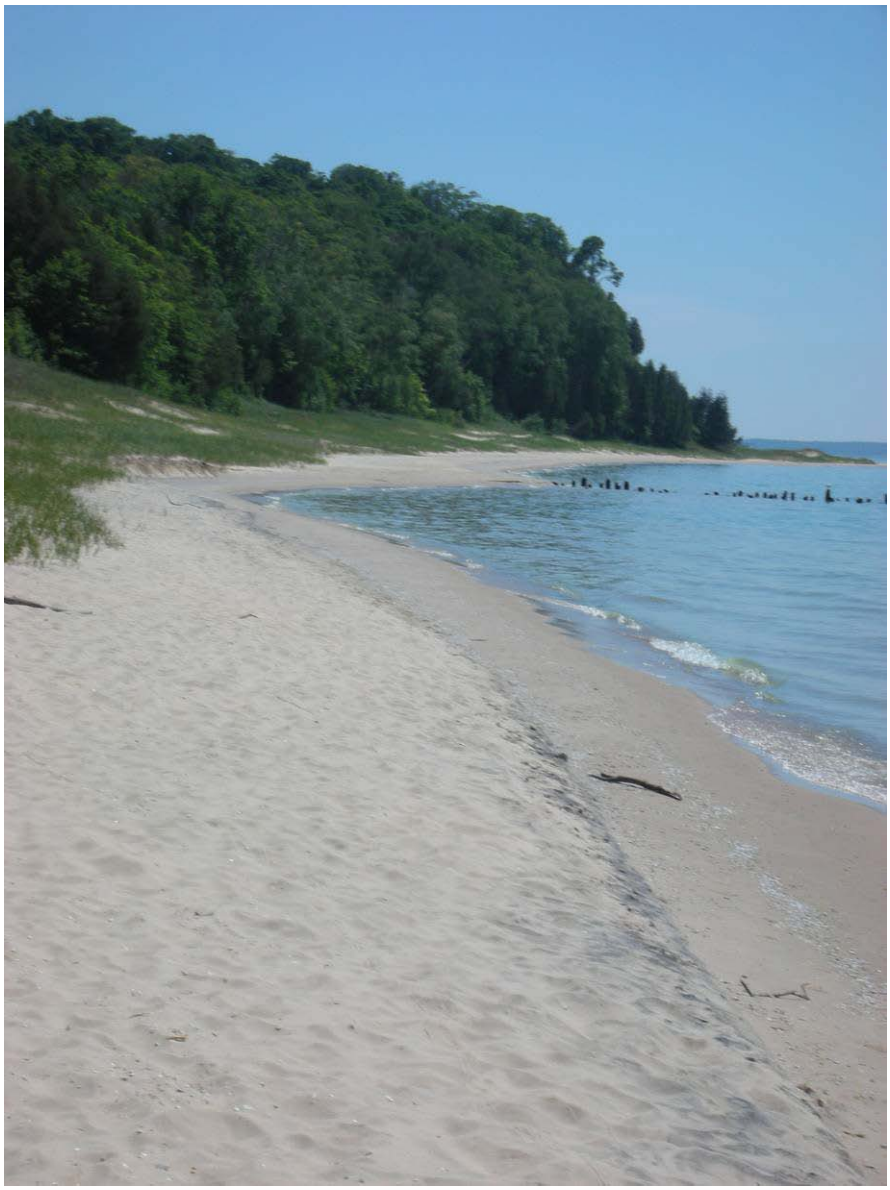


Table E-2. Map classification listing, sorted alphabetically by map-class code, used for the Sleeping Bear Dunes National Lakeshore (Michigan) vegetation mapping project.

Map-class Code	Map-class Name
CDV	Developed Area
DJD	Great Lakes Juniper Dune Shrubland
DLF	Leatherleaf Poor Fen
DLS	Leatherleaf - Sweetgale Shore Fen
FBA	Black Ash - Mixed Hardwood Swamp
FBM	Beech - Maple - Northern Hardwoods Forest
FBR	Aspen - Birch - Red Maple Forest
FBX	Hardwood Ruderal Forest (black locust phase)
FCA	White-cedar - Black Ash Swamp
FCB	White-cedar - Boreal Conifer Mesic Forest (yellow birch interior phase)
FCC	White-cedar - Boreal Conifer Mesic Forest (conifer phase)
FCM	White-cedar - Boreal Conifer Mesic Forest (maple coastal dune phase)
FCP	Spruce - Fir - Aspen Forest
FCS	White-cedar - (Mixed Conifer) / Alder Swamp
FCX	Conifer Ruderal Forest
FDX	Hardwood Ruderal Forest (hardwood mix phase)
FHB	Great Lakes Hemlock - Beech - Hardwood Forest
FHC	Hemlock Mesic Forest
FHS	Hemlock - Yellow Birch Swamp Wet-Mesic Forest
FJB	Jack Pine / Blueberry / Feathermoss Forest
FJO	Jack Pine - Northern Pin Oak Forest
FMA	Sugar Maple - Ash - Basswood Northern Rich Mesic Forest
FMX	Conifer - Hardwood Ruderal Forest
FOD	Deciduous Orchard
FOM	Northern Red Oak - Sugar Maple Forest
FPD	Great Lakes Dune Pine Forest
FPE	Conifer Plantation
FRA	Red Pine - Aspen - Birch Forest
FRM	Red Maple - Ash - Birch Swamp Forest
FRP	Red Pine / Blueberry Dry Forest
FSS	Black Spruce - Tamarack / Labrador-tea Poor Swamp (black spruce phase)
FTP	Black Spruce - Tamarack / Labrador-tea Poor Swamp (tamarack phase)
FTR	Northern Tamarack Rich Swamp
FTS	Central Tamarack Poor Swamp
FWA	White Pine - Aspen - Birch Forest
FWO	White Pine - Red Oak Forest
FWP	White Pine / Blueberry Dry-Mesic Forest
FWS	White Pine - Red Maple Swamp
HAB	Great Lakes Beachgrass Dune
HBF	Bracken Grassland
HCC	Bluejoint Wet Meadow
HCF	Crop Field
HCM	Midwest Mixed Emergent Deep Marsh
HCP	Inland Coastal Plain Marsh
HDW	Interdunal Wetland
HEM	Northern Great Lakes Emergent Marsh

Map-class Code	Map-class Name
HFA	Northern Water-lily Aquatic Wetland
HMX	Ruderal Grassland
HPB	Great Lakes Coast Pine Barrens (barrens phase)
HPF	Pasture Field
HPG	Eastern Reed Marsh
HPW	Great Lakes Coast Pine Barrens (woodland phase)
HSG	Northern Sedge Wet Meadow
HSM	Great Lakes Sedge Rich Shore Fen
HSS	Woolly-fruit Sedge Shore Fen
HSV	Midwest Pondweed Submerged Aquatic Wetland
HUS	Upright Sedge Wet Meadow
HWM	Wet Meadow Mixed Herbaceous
NSB	Sand & Cobble Beach
NSR	Stream & River
NWL	Open Water Lake
NWP	Open Water Pond
SAS	Gray Alder Swamp
SBC	Dogwood - Willow Swamp (black chokecherry phase)
SCW	Sand Cherry Dune Shrubland
SCX	Conifer Ruderal Shrubland
SDW	Dogwood - Willow Swamp (dogwood - willow phase)
SDX	Deciduous Ruderal Shrubland
SMX	Conifer - Deciduous Ruderal Shrubland
SSF	Shrubby-cinquefoil - Sweetgale Rich Shore Fen
VAV	Inland Freshwater Strand Beach
VBO	Great Lakes Beach (blowout phase)
VES	Great Lakes Beach (erodable sand bank phase)
WCD	Cottonwood Dune Open Woodland

Appendix F: Accuracy Assessment Form

NATIONAL PARK VEGETATION MAPPING PROGRAM: ACCURACY ASSESSMENT POINT FORM

IDENTIFIERS/LOCATORS

Field Point Code _____ Database Point Code _____

State _____ Park Name _____ Park Site Name _____

Quad Name _____ Quad Code _____

Primary Veg Assoc Name _____

Secondary Veg Assoc Name _____

Other Veg Assoc within 50 m _____

Classification Comments:

GPS file name _____ Field UTM X ___ ___ ___ ___ ___ ___ m E Field UTM Y ___ ___ ___ ___ ___ ___ ___ m N

GPS Error _____ m

please do not complete the following information when in the field

Corrected UTM X ___ ___ ___ ___ ___ ___ m E Corrected UTM Y ___ ___ ___ ___ ___ ___ ___ m N UTM Zone_____

Survey Date _____ Surveyors _____

ENVIRONMENTAL DESCRIPTION

Elevation _____ Slope _____ Aspect _____

Topographic Position

Landform

Environmental Comments (including hydrology):

Unvegetated Surface: *(please use the cover scale below)*
___Bedrock
___Litter, duff
___Wood (> 1 cm)
___Large rocks (cobbles, boulders > 10 cm)
___Small rocks (gravel, 0.2-10 cm)
___Sand (0.1-2 mm)
___Bare soil
___Other: _____

VEGETATION DESCRIPTION

Leaf phenology
(of dominant stratum)
Trees and Shrubs
___Evergreen
___Cold-deciduous
___Drought-deciduous
___Mixed evergreen - cold-deciduous
___Mixed evergreen - drought-deciduous

Herbs
___Annual
___Perennial

Leaf Type
(of dominant stratum)
___Broad-leaved
___Needle-leaved
___Mixed broad-leaved/Needle leaved
___Microphyllous
___Graminoid
___Forb
___Pteridophyte

Physiognomic class

___Forest
___Woodland
___Shrubland
___Dwarf Shrubland
___Herbaceous
___Nonvascular
___Sparsely Vegetated

Cover Scale for Unvegetated Surface

01	5%
02	10%
03	20%
04	30%
05	40%
06	50%
07	60%
08	70%
09	80%
10	90%
11	100%

Strata	Height	Cover Class	Dominant species (mark any known diagnostic species with a *)	Cover Class
T1 Emergent	_____	_____	_____	
T2 Canopy	_____	_____	_____	
T3 Sub-canopy	_____	_____	_____	
S1 Tall shrub	_____	_____	_____	
S2 Short Shrub	_____	_____	_____	
S3 Dwarf-shrub	_____	_____	_____	
H Herbaceous	_____	_____	_____	
N Non-vascular	_____	_____	_____	
V Vine/liana	_____	_____	_____	
E Epiphyte	_____	_____	_____	

Comments

Cover Scale: Strata and Species	
01	5%
02	10%
03	20%
04	30%
05	40%
06	50%
07	60%
08	70%
09	80%
10	90%
11	100%

Height Scale: Strata	
0	<0.5 m
02	0.5-1 m
03	1-2 m
04	2-5 m
05	5-10 m
06	10-15 m
07	15-20 m
08	20-35 m
09	35-50 m
10	>50 m

Appendix G: Accuracy Assessment Contingency Table

Explanation of the Contingency Matrix

The accuracy assessment (AA) contingency matrix for the Sleeping Bear Dunes National Lakeshore vegetation map layer is an array of numbers set out in rows and columns to compare results of vegetation types represented on the map layer to vegetation types as verified on the ground. Map-class codes are used to identify vegetation types for ease of comparison during the analysis and are listed at the side of each row and the top of each column. (A crosswalk between map classes and vegetation types is provided in the Main Report and in Appendix E: Descriptions of Map Classes. The crosswalk reveals the various vegetation types assigned to the map-class codes that are used to label vegetation types in this contingency table.) Map-class codes that are grouped together within parenthesis are map-class phases to one particular association type; these phases were assessed together. Map-class codes that are grouped together but are *not* within parenthesis are individual map classes, and each represent an association type. These were merged together for AA purposes to meet program accuracy standards. In both cases, the map classes and map-class phases are kept separate within the map layer.

The columns represent vegetation types in the National Vegetation Classification Standard (NVCS), Version 2 (FGDC 2008). These columns tabulate the producer's accuracy by showing errors of exclusion (omission errors) present in the map. The rows represent the map classes listed by their respective map-class codes. (Again, refer to the crosswalk for map class-names and links to vegetation types.) These rows tabulate the users' accuracy by showing errors of inclusion (commission errors) present in the map.

The following contingency matrix is formatted to a tabloid-size page (11" x 17") in landscape orientation.

		FIELD SAMPLES - REFERENCE DATA																																				COMISSION			
	MAP CODES	FPD	FJB	FRP, FWP, FRA, FWA	(FSS, FTP)	FCS, FBA, FCA	FHS	FBM, FMA	FOM	FBR	FRM	FTR	FTS	FWO	FJO	FHC	FHB	(FCB, FCM, FCC)	FCP	FWS	WPB, WCD	SCW	SAS	(SDW, SBC)	SSF	DJD	DLS	DLF	HAB	HWM, HCC	HDW	HSG, HUS	HCP	HSM, HCM, HEM, HSS	HPG	(HPB, HPW)	HBF	HSV	HFA	(HBO, HES)	HAV	TOTAL	USERS' ACCUR-ACY	90% Confidence Intervals -	90% Confidence Intervals +
MAP DATA - PREDICTION DATA	FPD	20	4	3														1																		1						29	69%	53%	85%
	FJB		23	1										2	2															1						1						30	77%	62%	91%
	FRP, FWP, FRA, FWA	1		96						1				15	3	1	2																			1						120	80%	74%	86%
	(FSS, FTP)				4																		1																		5	80%	41%	119%
	FCS, FBA, FCA					59	2	1			5	1	2					1		2			9	1				2		1		1		1				1				89	66%	57%	75%
	FHS					3	2																																			5	40%	-6%	86%
	FBM, FMA							56		1	1						2																									60	93%	87%	99%
	FOM							3	24	2				1			2																										32	75%	61%	89%
	FBR			1				7		21						1								1																		31	68%	52%	83%
	FRM			2		2				2	23																															29	79%	65%	93%
	FTR											5																														5	100%	90%	110%
	FTS												1																													1	100%	50%	150%
	FWO								1					26			2																										29	90%	79%	101%
	FJO													1	4																												5	80%	41%	119%
	FHC					5										14		1																									20	70%	51%	89%
	FHB					1	1			1						1	26																										30	87%	75%	99%
	(FCB, FCM, FCC)	1		1		5	1	2			1			2		2	1	40								1			1													58	69%	58%	80%
	FCP									1								1	3																								5	60%	14%	106%
	FWS						1													4																							5	80%	41%	119%
	WPB, WCD							2													33	3				1																39	85%	74%	95%
	SCW																				1	14		1		1			1													18	78%	59%	97%
	SAS					1					1												26	2																			30	87%	75%	99%
	(SDW, SBC)					2														1			9	15								1		2								30	50%	33%	67%
	SSF																						2		2									1								5	40%	-6%	86%
	DJD																					1				30																31	97%	90%	104%
	DLS																										5															5	100%	90%	110%
	DLF																						1	2				17														20	85%	69%	101%
	HAB																	1									2		27									1				31	87%	76%	99%
	HWM, HCC																				1			2					2	31	2	4		8				1			51	61%	49%	73%
	HDW																														4										4	100%	88%	113%
	HSG, HUS																								1					2	1	13		4								21	62%	42%	82%
	HCP																																2								2	100%	75%	125%
	HSM, HCM, HEM, HSS																							1	1					4		3		48	2							59	81%	72%	91%
	HPG																																		5						5	100%	90%	110%
	(HPB, HPW)	1																				1					1									28					31	90%	80%	101%
	HBF																																				5				5	100%	90%	110%
	HSV																																					2			2	100%	75%	125%
	HFA																																						4		4	100%	88%	113%
	(HBO, HES)																					1							4										25		30	83%	70%	96%
	HAV																																		2					3	5	60%	14%	106%
OMISSION	Total	23	27	104	4	78	7	71	25	29	31	6	3	47	9	19	35	45	3	7	35	20	48	25	4	36	5	19	35	39	7	22	2	64	9	31	6	3	5	25	3	1016			
	PRODUCERS' ACCURACY	87%	85%	92%	100%	76%	29%	79%	96%	72%	74%	83%	33%	55%	44%	74%	74%	89%	100%	57%	94%	70%	54%	60%	50%	83%	100%	89%	77%	79%	57%	59%	100%	75%	56%	90%	83%	67%	80%	100%	100%	790			
	90% Confidence Interval -	73%	72%	88%	88%	67%	-7%	70%	88%	57%	60%	50%	-28%	42%	12%	54%	61%	80%	83%	19%	86%	51%	41%	42%	-4%	72%	90%	75%	64%	68%	19%	40%	75%	65%	23%	80%	50%	5%	41%	98%	83%	Total Samples = 1016			
	90% Confidence Interval +	101%	98%	97%	113%	84%	64%	88%	104%	88%	89%	117%	95%	68%	77%	93%	88%	98%	117%	95%	102%	89%	67%	78%	104%	95%	110%	104%	90%	91%	95%	79%	125%	85%	88%	101%	117%	128%	119%	102%	117%	Total Correct = 790			

OVERALL ACCURACY = 77.8% KAPPA INDEX = 76.7% KAPPA INDEX LOWER 90% CONFIDENCE LEVEL = 74.5% KAPPA INDEX UPPER CONFIDENCE LEVEL = 78.9%

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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